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## Forthcoming Events.

FEBRUARY 29.

*Sheffield Society of Engineers and Metallurgists* :—Dinner at Sheffield.

MARCH 1.

*Institute of British Foundrymen (Lancashire Branch)* :—Ordinary meeting at Manchester. "Some Experiences with Jolt Ramming," Paper by A. L. Key.

*Swansea Technical College Metallurgical Society* :—General meeting at Swansea. "The Manufacture of Steel in Open Hearth Furnaces of the Fixed Type," Paper by E. Williams.

MARCH 4.

*Institute of Metals (North-East Coast Local Section)* :—Ordinary meeting at Newcastle-on-Tyne. Discussion on "Alloys for Use with Superheated Steam," by H. J. Young.

*Institute of British Foundrymen (Lancashire Branch, Burnley Section)* :—Ordinary meeting at Burnley. "Dry Sand and Loam Moulding," Paper by A. Sutcliffe.

MARCH 6.

*Institute of British Foundrymen (London Branch)* :—Ordinary meeting in London "Malleable Iron Chain," Paper by J. W. Gordon.

**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.**

***Institute of British Foundrymen.***

**PRESIDENT, 1923-24, Oliver Stubbs, M.I.Mech.E., Openshaw, Manchester.**

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**Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.**
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**West Riding of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.**

***Welsh Engineers' and Founders' Association.***

**Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.**

## Ideal Foundry Research.

The British Cast-Iron Research Association has now been operating for close on three years, and has undoubtedly done some good groundwork, but the foundry public is still waiting for *a definite research on a basic problem*. As much of its work is of a confidential character, it is difficult to estimate what value it has been to the industry, but an outstanding point which must be kept uppermost in the mind is the fact that, after the expiration of another two years, the Government pound for pound subsidy ceases. It is therefore imperative that the Association must make such progress during this period that it can remain self-supporting. A certain amount of the work tackled certainly relates to what might be termed "day-to-day" problems. The urgency of these, due to the necessity for delivering the castings to which the problems relate, does not allow of intensive investigation, and can scarcely be called research. They are problems which many people believe should be left to the consulting foundry expert or metallurgist.

The type of research that is definitely the work of a research organisation must be of a *fundamental character*, and be of basic interest to a minimum of 80 per cent. of the iron foundries, and if possible, more. Some directorates of foundry concerns are at present unable to visualise how this is to benefit them directly, and we suggest that there is a distinct need for intense propaganda by research organisations on this particular point — the solution of "day-to-day" problems is too chimerical.

The type of research which we believe would be most acceptable to the large majority of foundries —that is, over 85 per cent.—would be those relating to cupola practice, blow holes, shrinkage, and the influence of sulphur on cast iron. The research on cupola practice we suggest should be carried out on a similar basis to that employed by Mr. Fred Clements in his monumental Paper read before the Iron and Steel Institute on British Open-Hearth Practice, which definitely outlined the working details of a large number of plants, from which those in charge can draw their own conclusions. A similar research on cupola practice, intelligently prosecuted and interpreted, would save British foundries thousands of pounds a year.

A reasoned study on blow holes and allied defects would be most welcome, and there now exists much data, which only requires sifting and arranging in order to place foundrymen in an excellent position to help themselves.

A research on shrinkage, to be of general application, can be a most expensive matter, as it is probably influenced by mass effect, but if those responsible will keep their mind fixed on the production of results beneficial to the greatest number, much useful work could be rapidly available. The study of sulphur in cast iron is an involved one, and a readily-interpreted statement of its general and particular influence on the various grades of cast iron, even in the light of present knowledge, would help to diminish the number of those vexing day-to-day problems, or at least bring this aspect of the case into its correct perspective.

We suggest that the best propaganda for the B.C.I.R.A. would be for the free publication of a fundamental research for the general good of the industry. We realise that this is asking much, but if it proves to be a means of inducing more foundries to co-operate, and so expand the field of activity, then it should be worth while.

# Correspondence.

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

### The Draughtsman and the Foundry.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the Paper by Mr. F. C. Edwards on "The Draughtsman and the Foundry," appearing in the February 14 issue of THE FOUNDRY TRADE JOURNAL, and also your leader on the same subject. It would appear that Mr. Edwards considers that the draughtsman does not get a fair show in the columns of the technical Press, and that if more space were devoted to his interests it would tend to bring the draughtsman and the foundryman closer together, which would be of advantage to the industry generally.

There may be some grounds for this contention, but they are very slight, for the fact remains that the draughtsman is usually trained as an engineer, and in that training foundry work has little or no place. The designing of castings is incidental to his calling, but it is done from the view-point of the engineer, which does not admit of factors of importance from the view-point of the foundryman.

There is something to be said for the suggestion that the draughtsman should be in close touch with pattern-shop and foundry, and take advantage of every opportunity that presents itself to secure the view-point of these departments. Equally there is much to be said for the suggestion that the foundryman should study machine drawing and design, so that he can constructively criticise all drawings and patterns passing through his hands. Both suggestions are good, but neither gets to the root of the matter. Bearing in mind that the draughtsman has been trained as an engineer, it is obvious that his association with the foundryman *after* he has completed his training will not cause his view-point to alter to any appreciable extent. It may cause him to modify or amend his ideas in certain minor instances, but it will never cause him to look at the matter as a whole from the foundryman's standpoint, because his training is based upon certain principles, and those principles can never be eradicated.

That this is not disputed is shown in your leader, where appears the suggestion that the foundryman should be competent constructively to criticise the work of the draughtsman. This implies that there will be something to criticise, and it is safe to suggest that in every case the affair would result in compromise—with neither party satisfied.

It is the training of the draughtsman that is at fault, and will continue so until the engineer's training includes foundry work. The importance of this is recognised in the paper under review, for in the event of a large casting being scrapped, responsibility being repudiated by the pattern-maker and the foundry manager, the general manager is expected to give a decision. It is rightly argued that the foundry manager should not have to decide, but in most cases he *does* so, because the general manager's knowledge of foundry work is but slight. *He has been trained as an engineer.*

It does not appear unreasonable to suggest that, if the foundryman is to qualify to act as a constructive critic of the work of the draughtsman, he should not go a step further and qualify as a foundry draughtsman. It may be contended that there is little scope, but, taking into consideration two important facts, viz.: (1) that there are a very large number of foundries in the country, and the number is likely to increase considerably ere long; and (2) that there is a tremendous amount of wastage annually owing to the inability of the engineer draughtsman to deal with foundry designs from a foundry view-point, it appears to the writer that there is ample scope for the foundry draughtsman.

This also would have the effect of improving the status of the foundryman, for it would open up the road to promotion. So far the foundryman can aspire to the positions of chargehand, foreman, and foundry manager, but these positions are few when compared with the number of aspirants. Add to these the position of draughtsman, and a splendid opportunity for advancement presents itself, which will surely be taken advantage of by the ambitious foundryman. Enthusiasm would be stimulated, and boys would more readily embrace foundry work as a calling.—Yours, etc.,

H.

### Newcastle Junior Section.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of February 7 there is an account of a speech given by Mr. J. Ellis at Cardiff.

Whilst thanking him for his kind reference to the Newcastle Junior Section of the Institute of British Foundrymen it should be pointed out that this section is not wholly composed of boys under 18 years of age.

Our age limit is 26, but we have a special grade of membership for boys under 18, and it is these boys whom we particularly desire to have as members.

In Newcastle there are no evening classes where foundry apprentices can learn the technical side of their own trade; they seem to be neglected, and if a boy does not understand why he does a certain thing when working, but has just to do it, then it can hardly be expected that he should exhibit that keenness for his work which would accrue if his practical knowledge was augmented with a little theory or practical explanation.

It was for this reason that the Junior Section was formed, believing that if by the reading of elementary practical and theoretical papers on subjects connected with the foundry and allied trades during the winter months, and by visits to various works during the summer, the "foundryman of to-morrow" would be stimulated into taking pride in his work and developing his own initiative, then the difficulty of getting boys into the foundry would be well on the way of being eliminated, and a much happier feeling of confidence would be established in the young man's mind for any work which he may have to undertake.—Yours, etc.,

W. P. GOSPEL,
Hon. Sec., Newcastle Junior Section.

## Newcastle Convention.

The Newcastle Convention of the Institute of British Foundrymen is to be held from Wednesday, June 4, to Friday, June 6. Capt. Wood, of the North-Eastern Marine Engineering Company, is acting as chairman of the Reception Committee, and Mr. Colin Gresty has been asked to act as honorary secretary to the committee. An appeal is being circularised with the object of raising £500 for the entertainment of the visitors. The Literary Committee of the I.B.F. are co-operating for the provision of papers. Two of an international character are already promised. The American Foundrymen's Association Exchange Paper is to be presented by Mr. J. Fletcher Harper, of the Allis Chalmers Manufacturing Company, Milwaukee, Wis., who, it is expected, will deal with the casting of large engine parts.

The second international paper promised is by Mr. Van Aarst, of Holland, who will deal with some phases of foundry practice.

Suggestions and offers of papers should be sent to Mr. W. G. Hollinworth, the general secretary of the Institute, at 38, Victoria Street, London, S.W.1.

## The International Foundry Trades' Exhibition.

June is likely to be a busy month for foundrymen. The Institute Conference, which is to be held during the week prior to Whitsuntide, is to be followed by the International Foundry Trades' Exhibition at Bingley Hall, Birmingham, on June 19. It will remain open until June 28. It is confidently expected that the British Empire Exhibition at Wembley Park will largely swell the number of Colonial and foreign visitors. We shall be pleased to advise such persons as to the best means of utilising the time at their disposal. Details of the arrangements for the exhibition are now available on application to Mr. C. Stanley, Exhibitions manager, The Birmingham Chamber of Commerce, New Street, Birmingham.

## Book Review.

**The Manufacture of Electric Steel**, by Frank T. Sisco. Published by Messrs. McGraw Hill Publishing Company, Limited, 6, Bouverie Street, London, E.C.4.

We like the arrangement and ground covered by this book. It is written by an American, and their methods differ from those in use in Europe. For instance, the use of limestone instead of lime appears to be general. This he charges direct on the furnace bottom. If he used lime instead of limestone and did this with a not very hot conducting hearth furnace, it is probable that the hearth would be temporarily insulated. If a furnace hearth is getting thin it is usual to charge lime first in British practice as it tends to make the hearth grow. If, on the other hand, it is desired to deepen the hearth, rusty scrap is first charged. This way of controlling the depth of a furnace is better practice than excessive fettling with dolomite or flowing down with either spar or sand. Again, in American practice the use of magnesite for making furnace hearths seems to be preferred to the use of dolomite, which is the reverse in Europe.

One receives the impression when studying American electric furnace practice that conductive hearth furnaces are not a universal success. They had an erratic career in the early days in Great Britain, but this no longer exists. No mention is made of the incorporation of highly electrically conductive material in the lower portions of the hearth—a factor which has materially contributed to the success of the Greaves-Etchell and Electro-Metal furnaces in Europe.

Another important factor which one gathers from the book is still little understood in the States is the use of electrode economisers. We consider the subject warrants a special chapter.

The book contains 13 chapters, and is well illustrated, and we note with pleasure that the models of 15 years ago have been left out. The book is not a compilation from manufacturers' catalogues but an honest review of the principal furnaces of the world by a man who has obviously controlled electric furnaces. There is nothing very novel disclosed, but if it describes the present position of the art in the States, as we believe it does, then it is worthy of close study by all connected with the industry in Europe.

## The Institute of British Foundrymen.

### Another Cardiff Propaganda Meeting.

Owing to the interference of the railway strike with the meeting held on January 26 and in consequence of the very keen interest displayed by the foundrymen in Wales in the effort made to form a Branch of the Institute of British Foundrymen, the Council have decided to hold a further meeting in the Cardiff Technical College, Cathays Park, Cardiff, on Saturday, March 1, at 6 p.m.

The President of the Institute, Mr. Oliver Stubbs, M.I.Mech.E., of Manchester, will preside.

A discussion on general foundry practice will be opened by Mr. Dudley Haines, B.Sc., and an opportunity will be afforded the audience to take part.

It is hoped this meeting will result in a Branch in Wales taking definite form. The Secretary will be glad to have the names and addresses of those desirous of joining handed in at the meeting or proposal forms will be welcomed prior to the meeting. These should be forwarded to Mr. J. J. McClelland, Druslyn, Bishop's Road, Whitchurch, Glam. This would greatly facilitate arrangements for completing the formation of a Branch.

Proprietors and managers are respectfully requested to pass on invitations to their staff, including those in the pattern shop, laboratories and melting departments.

Admission to the meeting is free, and all interested in the trade are cordially invited to be present.

## A Note on the Difficulties of Casting Aluminium Alloys.

**By Neville Dean.**

Whilst the foundryman experiences most of the usual casting difficulties in connection with aluminium alloys, there are some which appear to be almost inseparable from this metal.

These are: a likelihood of short-running thin sections; a very strong tendency to blow-holes on thick sections, and to a large extent contraction and shrinkage defects.

The tendency to short run is best overcome by judicious gating and tilting of the mould rather than by overheating the metal. It is bad practice to overheat the metal to such an extent that the casting is stained yellow round the gates, yet, as some patterns are designed, it is almost impossible to get a perfect casting without this stain. Of course the strength of the metal is sure to suffer in such a case, but it can hardly be said to be the caster's fault.

With reference to a predilection for forming blow-holes this is owing to the low specific gravity of the metal. If the mould be rammed hard the pressure of the metal is insufficient to force the gases through the sand, and consequently blow-holes will be formed in the body of metal. Here it is most important that the sand is lightly but evenly rammed, not too wet, and even if necessary dried before casting, and the mould should be well vented on the top.

In connection with a too-damp mould, even in the case of thin sections, where blow-holes could not be formed, the surface of the castings may be roughened and spoiled. In such a case a light surface drying will produce a far superior surface on the casting, well worth the extra trouble involved. However, it is good practice to use sand with the minimum amount of water necessary to form a bond.

Defects due to contraction and shrinkage are too numerous to mention, but the remedy lies first of all in good design, avoiding sharp changes in section where possible. Additionally, all bosses or heavy masses of metal should be adequately fed, or where such cannot be fed some means of chilling should be provided to make the rate of cooling uniform throughout the casting.

## Foundry Queries.

### Oil Sand Cores.

Due to our having received lately orders for castings of a smaller character, whereas previously we were more interested in heavier work, we have lately considered the advisability of using oil cores in place of green sand cores, and we should esteem it a favour if you could inform us—(1) Whether oil cores would enable us to produce these castings cheaper; (2) if our first question is in the affirmative, would you give us some idea of what plant we should require to produce satisfactory oil cores, and what material we should have to stock for such purpose. Generally speaking, we know what is required, but we should like to have some expert advice on this question.—P. B.

### Alloy Casting.

I should deem it a favour if some reader would give me any hints as to how the following alloy—60 lead, 33 nickel, 7 copper—should be cast in order to obtain a thorough amalgamation of the constituents and so avoid the nickel rising to the top of the castings.—C. B. C.

**Industrial Welfare Society.**—The interest of its member firms in accident prevention has encouraged this society to publish a memorandum on the subject. Every month over 200 workpople are killed in the course of their employment, while the latest report of the Chief Inspector of Factories shows that 843 persons were killed and 97,986 were seriously injured during 1922 in factories and workshops alone. These figures do not include mines where the accident rate is high. Some 80 per cent. of accidents in factories and workshops are the result of failure on the part of the human element—carelessness, familiarity with danger, etc. Copies of the memorandum may be obtained from the Society, 51, Palace Street, Westminster, S.W.1.

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## Company News.

**A. G. Steel Supplies, Limited,** 58, Mitchell Street, Sheffield.—Capital £1,000 in £1 shares. Director: A. R. Garner.

**Gerrard Wire Tying Machine Company, Limited,** London House, Crutched Friars, London, E.C.—Capital £10,000 in £1 shares.

**Davis Steel Wheel Company, Limited,** 15, Bedford Row, London, W.C.1.—Capital £9,000 in £1 shares. Directors: W. H. White and T. Outen.

**Silica Brick and Machinery, Limited,** 2, Great Winchester Street, London, E.C.—Capital £5,000 in £1 shares. Directors: G. C. Welborn and W. H. G. Jenkins.

**Stevenson & Turner, Limited,** 1, West Street, Smithfield, Belfast.—Capital £45,000. Lead manufacturers and metal merchants. Directors: J. Turner and D. McAllister.

**J. Nickels & Son, Limited,** 10-11, Bath Street, Liverpool.—Capital £8,000 in 7,990 preference shares and 10 management shares of £1 each. Engineers, etc. Directors: J. Nickels and A. E. Nickels.

**William Donald & Company (Glasgow), Limited,** 19, St. Vincent Street, Glasgow.—Capital £10,000 in £1 shares. De-hydrators and evaporators, calciners, lime burners, etc. Director and secretary: W. Donald.

**Place's Dobbys, Limited,** Whalley Ironworks, Whalley, Lancs.—Capital £5,000 in £1 shares. Ironfounders, mechanical engineers, textile machinists, etc. Directors: R. H. Place and J. H. Place. Secretary: E. Wood.

**A. R. Willmott & Company, Limited.**—Capital £1,000 in £1 shares (500 cumulative 7 per cent. preference). Mechanical, electrical and general engineers, etc. A. R. Willmott, of 43, Hawthorn Avenue, Norbury, is first and permanent director.

**W. Emery & Company, Limited,** 167, Arundel Street, Sheffield.—Capital £20,000 in 15,000 7 per cent. cumulative preference and 5,000 ordinary shares of £1 each. Brass and ironfounders, etc. L. Britton is permanent managing director and chairman.

**Reflex Metal Company, Limited,** 2, London House, Red Lion Square, Hampton-on-Thames, Middlesex.—Capital £1,100 in 1,000 £1 founders' A and 2,000 1s. founders' B. Directors: E. Lock, W. E. Chaplin, F. Cooper, R. Cooper, E. C. St. Aubyn, J. Dunkley and E. J. Ryan.

**Mather & Platt, Limited.**—Net profits, £325,291; income tax equalisation account, £47,302; interim dividends, £78,183; brought forward, £174,953; further dividend on ordinary, 5 per cent., making 10 per cent. for year, free of tax,; bonus, 5 per cent., free of tax; reserve, £50,000; carried forward, £178,393.

**Hoare & Company (Engineers), Limited.**—Capital £100,000, to adopt an agreement with Messrs. H. J. Hoare, J. M. Dick and H. J. Adkins, and to carry on the business of engineers as formerly carried on by them at the Colombo Engineering Works, Colombo, Ceylon, as Hoare & Company. Secretary: Mr. J. C. Gibson, 10, New Broad Street, London, E.C.

**W. T. Henley's Telegraph Works Company, Limited.**—Profit, £208,014; brought forward, £323,988; income tax for year, £20,171; reserve, £25,000; to reserve against trustee securities, £1,156; preference and interim ordinary dividends, £41,500; a final dividend on ordinary shares, 2s. per share, less tax, making 3s. for year, or 15 per cent.; carried forward, £379,175.

## Contracts Open.

**Aberdare.**—Stores, for the Powell Duffryn Steam Coal Company, Limited:—(1) Bar and other iron; (2) bolts, nuts, rivets, etc.; (3) gunmetal fittings; (5) colliers' tools; (6) ironmongery; (6a) ambulance sundries; (7) steel girders, channels and rails; (8) nails; (10) cast steel, tram wheels, axles, etc.; (11) steam and "Williams" joint tubes and fittings; (14) chains; (20) wire ropes, etc.; (21a) pit-props; (22) lime and cement; and (23) electric cable, accessories, etc. The Stores Manager, Aberaman Offices, Aberdare.

**Bridgend,** March 2.—Providing and laying 3-in. diameter cast-iron mains, for the Mid-Glamorgan Water Board. Mr. E. W. Davies, superintendent and manager, Water Board Offices, Bridgend. (Fee, £1 1s., returnable.)

**Chipping Norton,** March 4.—Providing and laying about 544 lineal yards of 2-in. wrought-iron galvanised screwed and socketed water pipe and specials, for the Town Council. Mr. R. Stanton, borough surveyor.

**Grimsby,** March 3.—Steam and other pipework, for the Corporation. Mr. W. A. Vignoles, Electricity Works, Grimsby.

**Leeds,** March 4.—Stores, for the Tramways and Highways Committee. The General and Commercial Manager, Tramway Offices Leeds.

**Newton Abbot,** March 3.—Providing and laying about 2,300 yards of galvanised water mains of various sizes, for the Committee of the Devon County Show, Newton Abbot, 1924. Mr. R. A. Rogers, surveyor, Union Street, Newton Abbot.

**London,** March 7.—(1) 100 four-wheel steel ballast wagons (M.G.); (2) four bogie petrol tank wagons (M.G.), for the South Indian Railway Company, Limited, 91, Petty France, Westminster, S.W.1. (Fees, (1) £1, (2) 10s. non-returnable.)

**Mossley.**—Alterations and extensions to gasworks, comprising new retort house and coal-handling plant, stoking machinery, coke-handling and screening plant, new purifiers, alterations to existing beds of retorts, erection of telpher and track, construction of new boiler-house, pump-house and power-house, for the Corporation. Mr. W. Bennett, engineer and manager, Gasworks. (Fee, £10 10s., returnable.)

**Sofia,** March 15.—According to Reuter's, the Minister of Commerce, Industry and Labour is inviting tenders for the supply of the metal parts of 2,000 mine tubs. The estimated cost is 6,927,300 leva.

**Wellington, N.Z.,** March 13.—Cast-iron pipes, etc., for the Wellington City Corporation. The Department of Overseas Trade.

## Obituary.

ENGINEER-COMMANDER F. A. GORDON, R.N., late Glasgow manager for David Brown & Sons (Huddersfield), Limited, gear specialists, of the Park Works, Lockwood, Huddersfield, died recently. His death, following a long illness, will be felt keenly throughout the engineering industry.

BY THE DEATH of Mr. H. Barlow-Massicks, J.P., which occurred at his residence, The Friary, Tickhill, recently, Rotherham is deprived of another of its public men. His connection with the firm of Steel, Peech & Tozer, Limited, the Icles, Rotherham, brought him into the town almost daily. It was his steel experience which introduced him to the district many years ago, and he had also family association with the firm. Mr. Barlow-Massicks, who was born at Whitehaven in 1857, commenced his industrial career at Millom Ironworks, where he ultimately became blast-furnace manager.

MR. B. HINGLEY died last week at his residence, at Cradley Heath, in his 89th year. The deceased was one of the many sons of Mr. Barbillar Hingley, of the same town, who was among the pioneers of the chain and cable industries. On the death of his father Mr. Hingley became one of the partners in the firm which bears his name, and on the death of his co-partner and brother he became sole proprietor. He was made a magistrate in 1907, and for many years he represented Cradley Heath on the Staffordshire County Council, being eventually raised to the aldermanic bench.

MR. J. BAKER, The Grange, South Road, Smethwick, who took a prominent part in the commercial and public life of Oldbury, died recently. Mr. Baker was for many years associated with the Metropolitan Carriage Works, at Oldbury, but of recent years he had been a director of a number of concerns in the district, including those of Accles & Pollock, Limited, Hunt Bros. (Oldbury), Limited, Tubes Investment, Limited, Bromford, Limited, Engineers and Ironfounders, Limited, Alfred Roberts, Limited, and J. H. Richards. In the public life of Oldbury Mr. Baker rendered service to the Higher Education Authority, and was also a Freemason. He was 49 years of age.

## A New 100-ton Tensile Testing Machine.

Last Monday saw the inauguration of a 100-ton tensile testing machine installed at the City of Birmingham Gas Department Industrial Research Laboratories by the Lord Mayor of Birmingham, Alderman T. O. Williams, J.P. This machine was made by Messrs. W. & T. Avery, Limited, and is of the vertical single lever type, operated by four straining screws which are driven through suitable reduction gearing by a 15-h.p. 440-volt motor. The machine can also be used for compression and transverse tests. The machine is controlled so far as the main motor is concerned by push button contactor switches. In the course of an address by the chairman of the Industrial Laboratory Sub-Committee (Alderman J. V. Stevens, J.P.), it was mentioned that Dr. C. M. Walter, the engineer in charge, had developed in collaboration with Messrs. Gibbons Brothers, Limited, of Dudley, a new type of regenerative town-gas fired furnace which was expected to effect considerable economies.

**International Test Bar Committee.**—Mons. Ronceray has written us pointing out that Mons. Albert Portevin and not Mons. Ramas is the chairman of the International Test Bar Committee.

# Modern Automobile Foundry Practice.*

By P. Pritchard.

(*Continued from page* 161.)

## Die-casting.

Aluminium is a metal which readily lends itself to casting in permanent moulds or dies, made either of iron or steel, on account of its fluidity and its comparatively low temperature in the molten state. Great progress has been made in this method of casting in recent years.

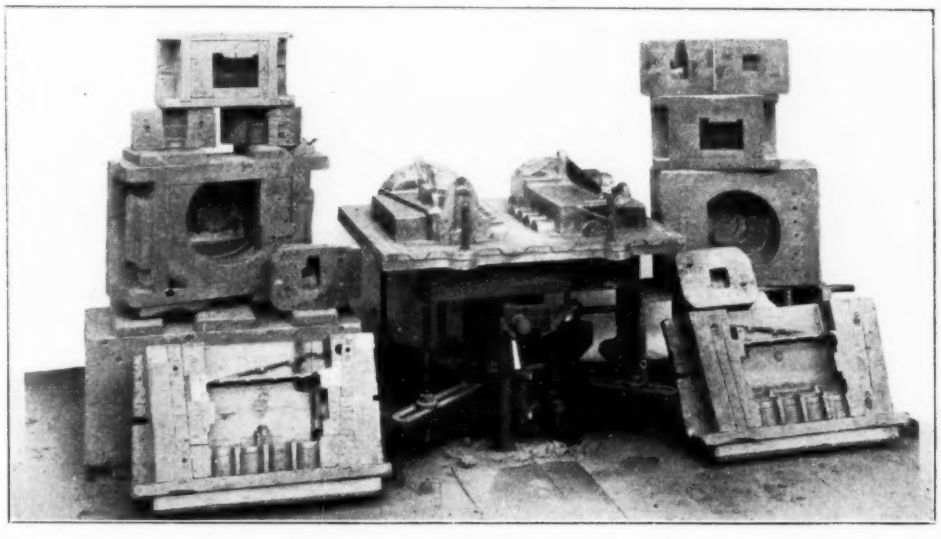

FIG. 10.—SHOWS THE PATTERN MOUNTED ON THE MACHINE, TOGETHER WITH THE NECESSARY CORE BOXES.

Die-castings can be divided roughly into two classes:—(1) Those made by the pressure process, which consists in forcing the molten metal under pneumatic or similar pressure into the dies. (2) Those made by gravity pressure, where the metal is poured into runner holes provided, allowing the die to fill naturally. Pressure die-castings have not so far been used largely in this country, although quite extensively used in the United States of America. The reason for this is:—(1) The initial expense of the plant is considerable, as compressed-air for forcing the metal into the moulds and steam for operating the machines are necessary. (2) The dies have to be exceptionally well made from nickel chromium or similar steels, and the cost of these would be out of all proportion to the number of castings usually ordered in this country. (3) It is difficult with the pressure process to ensure a perfectly sound and homogeneous casting every time, as the air in the die is frequently trapped by the metal. Very fine castings, however, are produced by this process both as regards appearance and accuracy.

Aluminium die-castings made by the gravity process are now being used to a considerable degree on the modern automobile, where quantities warrant the making of the die, and the design permits the use of a die-casting. Many advantages are claimed for die-castings, chief amongst which are the following:—(i) Rapid production of parts; (ii) uniformity of the product; (iii) accuracy of the casting; (iv) considerable economy owing to saving on machining and in the weight of metal required for the article; (v) superior finish; (vi) improvement in the physical properties of the metal; and (vii) reduction in the percentage of defective castings in machining shop.

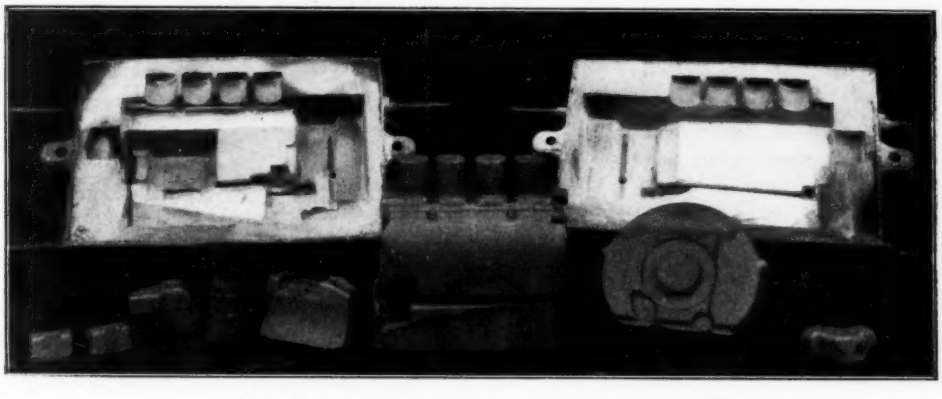

FIG. 11.—SHOWS THE MOULD AND A SET OF CORES.

It is not always possible to make every design of casting in a die, and when die-castings are desired it is sometimes necessary to modify the design in order to permit of the castings being so made, although in many cases the article can be produced without modification.

Figs. 13 to 17 illustrate the process of die-casting a four-cylinder crankcase for a well-known light car being dealt with, as it is representative of very advanced die-casting practice.

It is obvious that the dies constitute a large portion of the work involved in producing castings;

* A Paper presented to several branches of the Institution of Automobile Engineers. Mr. Pritchard is a director of the Midland Motor Cylinder Company, Limited, and is also connected with the Birmingham Aluminium Castings (1903) Company, Limited, and the Pneulec Machine Company, Ltd.



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indeed, much thought and experience have to be brought to bear upon a proposition before the die is even started upon.

The first step is to determine exactly how the casting shall be moulded; secondly, it is necessary to decide upon the size and position of the runners and risers; and thirdly, the design of die which will give the best results as regards long-life, accuracy of casting and ease in freeing the casting from the die. When this general outline has been

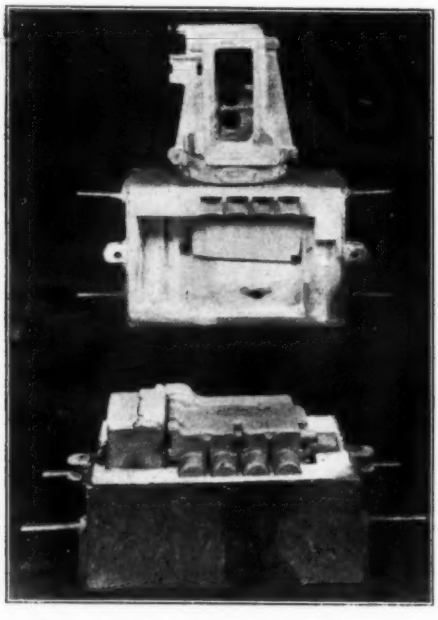


Fig. 12.—Shows the Mould Cored-up Ready for Closing, together with the Finished Casting.

decided upon, the next step is to prepare detailed drawings of each portion of the die, making due allowance for the ordinary contraction of the metal during cooling and then off-setting against this the expansion in the size of the die when heated up by being constantly filled with hot metal. Patterns have then to be made for those portions of the die

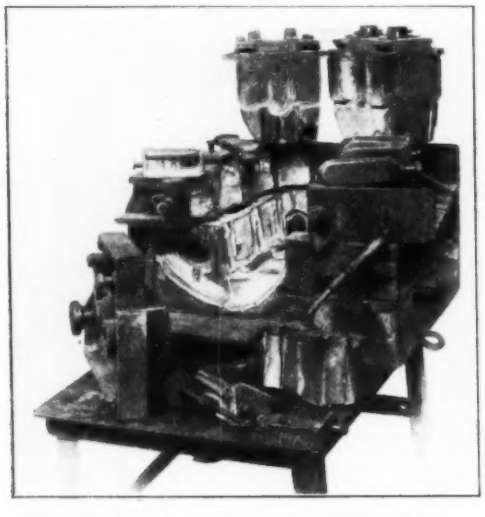


Fig. 13.—Shows the different Component Parts necessary for the Production of a Four-Cylinder Crank Case.

which cannot be made out of stock material, and from these patterns castings in a special-quality cast iron are made. These castings have to be correctly machined and most carefully fitted together in order to produce a casting free from flashes and unsightly joint marks. Frequently the shape of the die does not permit of the casting being machined out, in which case a lot of hand work has to be done, owing to the irregular shapes. It is not too much to say that the design and construction of the die is the most important factor in the successful production of die-castings. Even when the die is completed, the difficulties are not all overcome, and it is often found that initial casting difficulties are experienced. There may be difficulty in freeing the casting from the mould, or certain portions of the die cannot be removed quickly enough to prevent seizing, runners and risers sometimes have to be altered; in view of this, it is not altogether surprising that occasionally some time elapses between the commencement of making the die and the first delivery of satisfactory castings.

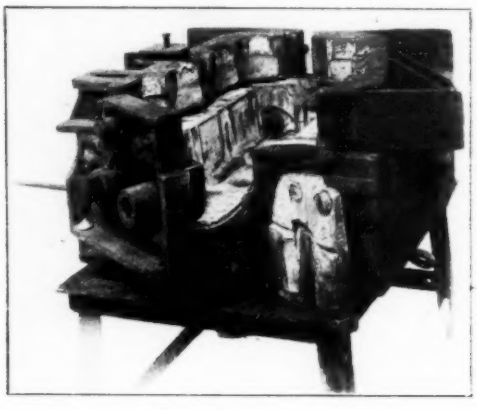


Fig. 14.—Shows the Die partly Assembled.

As with sand casting, the designer can be of great assistance to the maker of die castings by designing to suit the needs of the founder. Heavy bosses attached to thin sections should be avoided. Sharp corners are not advisable, whilst deep, narrow pockets, where the metal tends to seize on to the metallic core, are objectionable. Frequently much trouble and delay would be saved by a prior consultation between the designer and the die maker.

Although die-casting in aluminium is such a comparatively recent development, it has undoubtedly made greater progress than any other section of the foundry industry. The advantages of this process are considerable, and completely outweigh any minor disadvantages, and whilst it would be saying too much to claim that die-casting will be

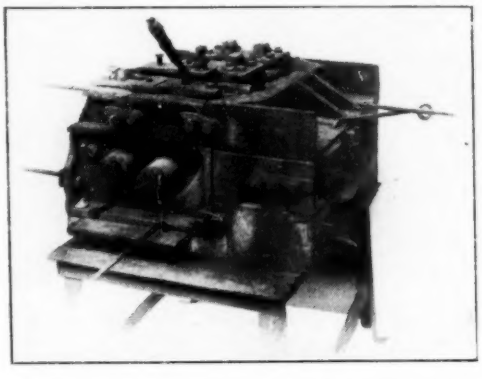


Fig. 15.—Shows the Fully Assembled Die Ready for Casting.

universally adopted for automobile work, it is likely that by far the greater percentage of aluminium castings used for this purpose will be made in dies in the near future.

### Cast-iron.

Cast iron for automobile use is divided into two classes:—(1) Grey cast iron; (2) malleable cast

iron. The former is largely used on automobiles for cylinder blocks, cylinder heads, exhaust pipes, and in some cases for flywheels, pistons, crankcases and transmission housings, in addition to many small odd castings. Grey iron castings are made from pig-iron derived from iron ore smelted in the blast furnace. Cast iron is, from a chemical standpoint, merely a very impure form of steel, the essential difference being that it contains a very much higher percentage of carbon and silicon, and in addition fair amounts of other impurities, such as phosphorus, sulphur, and manganese. These elements considerably affect the quality and strength of the metal according to the percentage

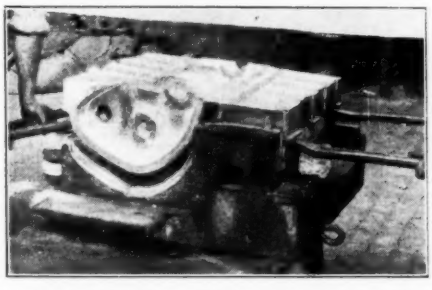


FIG. 16.—SHOWS THE DIE DISMANTLED AND THE CASTING BEING REMOVED.

contained therein. In the average foundry iron there is always between 3 and 4 per cent. of carbon. This carbon is present in two distinct forms:—(*a*) As graphitic, or free carbon; (*b*) in the combined state (*i.e.*, iron carbide). Carbon is the element which has the greatest influence upon the properties of the metal. The relationship of the two forms of carbon to each other determines the hardness or otherwise of cast iron, *i.e.*, if practically the whole of the carbon is present in the iron in the graphitic or free state the metal will be soft and open grained. As the proportion of combined carbon increases the graphitic carbon decreases, with a consequent hardening of the metal, until when most of the carbon is in the combined form the metal possesses a white fracture and is extremely hard. For average automobile work the total amount of carbon content in the iron is usually between 3 per cent. and 3.4 per cent., and of this amount from 0.4 to 0.8 per cent. is in the combined state, depending upon the hardness desired in the casting. The amount of *total* carbon present in cast iron is an important factor, as an excess amount of carbon produces a weak open-grained and poor-wearing metal.

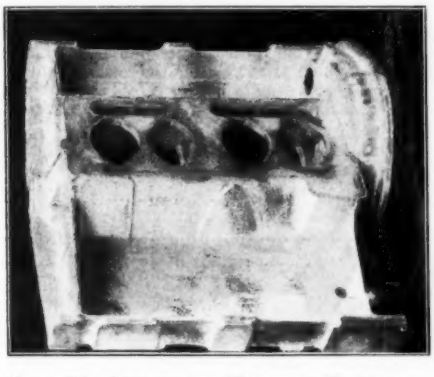


FIG. 17.—SHOWS THE FINISHED CASTING.

The next most important element in cast iron is silicon, which is present in percentages ranging from 0.5 to 4.5 per cent. The influence of this element is very peculiar and exceedingly important. The addition of silicon to the iron has the effect of changing the carbon present from the combined state into the graphitic state, and it is by varying the percentages of silicon that the desired hardness or softness is largely obtained. As the percentage of silicon is increased in the iron more carbon is converted from the combined form into the graphitic, and in consequence the iron is made softer. The usual percentage of silicon in cylinder iron in this country is between 1.25 per cent. and 2 per cent., although in America it is somewhat higher than this.

The remaining elements in iron are more or less impurities, and whilst some of them have beneficial effects, generally speaking, they are not added purposely. Phosphorus, of which the amount present in iron varies from 0.03 per cent. to 1.5 per cent., weakens the metal, especially at high temperatures when present in amounts over 1 per cent., and although it has the decided advantage of giving more fluidity to the metal, it is not regarded as good practice in high-class work to have the phosphorus content above 0.85 per cent.

Sulphur is always present in iron, and whilst not seriously detrimental in amounts of under 0.12 per cent., if this amount is exceeded the tendency is to harden the iron and often to cause small gas holes. It is usual to keep the sulphur content as low as practicable.

Manganese has the effect of neutralising the sulphur by combining with it to form manganese sulphide. In quantities over 0.7 per cent. it has the effect of closing the grain of the metal and slightly hardening it, although not to the same degree as would an equivalent reduction in the silicon content.

### Melting Cast-iron.

The furnace which is almost universally used for melting cast iron for automobile work is the cupola, and whilst it has many grave disadvantages it is the only form of suitable melting furnace available which will give the desired flexibility and lowest fuel consumption. The cupola roughly consists of a vertical steel cylinder from 20 to 30 ft. in height, and from 2 to 7 ft. in diameter according to capacity. It is lined with firebrick and generally provided with rows of tuyeres situated from 2 to 3 ft. from the bottom. These tuyeres admit the air under pressure from a suitable blower or fan which discharges into the air belt encircling the cupola at the point where the tuyeres are situated. The bottom of the cupola is made up with sand and a small hole (usually about 1 in. diameter) is left in the side of the cupola on a level with this bottom. This is called the tapping hole and provides the exit for the molten metal. Whilst the metal is melting and until a quantity sufficient for casting purposes has accumulated in the bottom of the cupola this hole is closed up by means of a soft clay plug squeezed in.

The operation of the cupola is as follows:—A fire is started on the sand bottom and good quality coke, containing about 90 per cent. carbon with as low a sulphur content as possible, is charged into the cupola until it is about half-full. The fire is allowed to burn until the whole of this coke is well alight. The first charge of metal in the form of pig and scrap is then placed on the top of this bed of coke, the weight of metal charged being from 5 cwt. to 1 ton, according to the size of the cupola. Next is added a small quantity of limestone for a flux, and then another layer of coke (equivalent to, roughly, 12 per cent. of the weight of the previous charge of iron) is placed on top of this and a further charge of iron and limestone added. Repeated alternating layers of coke and iron are charged until the furnace is full to the charging door, when the blower or fan is started.

The intense heat attained causes the metal in the first charge to melt and trickle through the bed of coke until it reaches the bottom of the cupola. It is allowed to remain here until a sufficient quantity has accumulated, when the soft clay plug is pierced with a sharp steel bar and the metal runs out into the receiving ladles for pouring into the moulds. Further charges of iron and coke are added as the metal melts.

Whilst the cupola described above is almost universally used in foundry work for melting iron, as before-mentioned it has several grave disadvantages when used for automobile or similar work requiring high-grade metal; chief amongst these are the following:—Owing to circumstances often beyond the control of the operator, the melting of the cupola may be erratic, one day the metal melted may be hot and fluid, the next day it will be cold and viscous, due to variation in the quality of the coke, the blast pressure or to erratic

charging. Since the metal in the cupola is in direct contact with the fuel, there is a great tendency for the iron to absorb carbon from the coke (especially at high temperatures), thus increasing the amount of total carbon present in the iron and causing weakness and open grain. Also, as the coke contains sulphur, this impurity is picked up by the metal during its passage through the cupola, while the high temperature and oxidising atmosphere in the cupola burn out a portion of the silicon and manganese present in the iron and alter the physical properties of the metal. It is, of course, usual to make a certain allowance for this when calculating the charges, but unfortunately the amount of oxidation varies considerably according to the working of the cupola, and consequently the resultant metal received in the ladle varies in proportion. In order to counteract some of the above-mentioned disadvantages steel scrap to the extent of from 5 to 20 per cent. of the total weight of metal is sometimes charged into the cupola. The resultant metal is often called semi-steel, although this is quite a misleading term, as the metal produced is still cast iron, although perhaps possessing superior physical properties. The effect of adding the steel is to assist in reducing the total carbon content in the metal and lowering the percentage of such impurities as phosphorus, and whilst not very popular in this country, there is no doubt that the addition of steel is beneficial to the metal, since it helps to produce a closer-grained and better-wearing material.

### Moulding.

The moulds for cast iron can be divided for the purpose of this Paper into two classes: (*a*) Green-sand moulds, *i.e.*, the mould is made with damp sand and is not dried before the metal is poured in; (*b*) dry-sand moulds, where the completed mould is taken into a stove and thoroughly dried. This procedure is necessary where the moulds are of a very fragile nature. In addition, with this process there is less tendency for gases to be generated with attendant risk of blow-holes, a smoother skin is imparted to the casting, and there is a lesser degree of hardness in the metal due to the absence of any chilling effect caused by the moisture present in green-sand moulds.

The sand used for moulding is a rock-sand containing a fair proportion of alumina necessary to bind the particles of sand together. When mixing the sand a small percentage of coal dust is often added to assist in giving a better skin to the casting. The sand is damped with sufficient water only to give the desired plasticity. Finely-ground plumbago is used to coat the surface of the mould to help in resisting the heat of the metal. For green-sand moulds the plumbago is dusted on dry and brushed over, whilst for dry-sand work the plumbago is mixed with water to form a wash and painted or sprayed on.

### Coremaking.

Oil-sand cores are almost universally used for automobile castings. The principle of oil-sand consists of taking a sharp sand, such as a seashore or similar sand containing a very high percentage of silica (up to 99 per cent.), and mixing with it from 1 to 3 per cent. of either linseed or similar oils containing a large proportion of gummy matter. The core is made from this mixture and baked for the requisite period at a temperature of 250 deg. C. This evaporates the volatile portion of the oil leaving a residue of gummy matter which binds the particles of sand together, and produces a strong, accurate core, which is very porous and allows the gases generated by the metal to escape readily. Immediately the metal is poured around the core in the mould the heat given off gradually disintegrates the gummy matter which binds together the particles of sand forming the core and allows the sand to return to its original powder form, thus enabling the core to be removed from the casting during fettling with far greater facility than would otherwise be possible.

*(To be continued.)*

**Increase in French Taxation.**—The Chamber of Deputies has voted the Government's proposal to increase all internal revenue charges.

## Personal.

MR. VINCENT DE FERRANTI, son of Dr. S. Z. de Ferranti, has now been elected a director of the firm of Ferranti, Limited.

MR. L. E. CANNING, of Scott, Harding & Company, Shanghai, importers of metals, machinery, etc., will shortly arrive in this country.

MR. W. H. COPLEY, of Hart, Moss & Company, has been elected to fill the vacancy on the board of the British Wagon Company, Limited, caused by the death of Mr. C. H. Moss.

MR. O. R. GIBBON, formerly of Tow Law, Co. Durham, has become a partner in the business of Sanders & Company, engineers' furnishers, etc., Alston Works, Ebenezer Terrace, Newport, Mon.

MR. LESLIE HOWE has been taken into partnership by Mr. George Walter, shipbroker and chartering agent, coal, iron and steel agent, 10, Great St. Helen's, London, E.C.3. The style of the new firm will be Walter & Howe.

MR. A. E. EASTHOPE has relinquished his position as works manager of Petters, Limited, of Yeovil, to join the British Thomson-Houston Company, Limited, at Coventry. Mr. E. P. Wrinch has been appointed to succeed him with the former firm.

MR. WILLIAM REGAN, lecturer and demonstrator at the department of metallurgy, Royal Technical College, Glasgow, has been appointed head of the chemical and metallurgical department of Wolverhampton Technical School in succession to Dr. J. T. Murray, new principal of Smethwick Technical School.

MR. H. E. J. CAMPS, consulting marine engineer and naval architect, has been nominated as Parliamentary candidate in the Unionist interest at the forthcoming by-election in the Burnley division of Lancashire. He is one of the founders of the Society of Consulting Marine Engineers and Ship Surveyors.

DR. R. V. WHEELER, director of the Eskmeals Experimental Station, and Professor of Fuel at Sheffield University, has left Liverpool for New York. He is going to the United States as the representative of the Institution of Mining Engineers at the annual congress of the American Institution of Mining Engineers. His other aim is to arrange with the American Bureau of Mines for closer co-operation between that body and the English Research Board on all questions relating to safety in coal mines.

ALDERMAN GEORGE GUMMER, J.P., who has resigned the presidency of the Northern Brassfounders' Association, is one of the foremost, if not the most prominent, public men in Rotherham. In 1874 he joined his father, the late Alderman W. H. Gummer, at the Effingham Brass Works, Rotherham, now carried on as Gummers, Limited, and of which he is chairman. As a member of the Rotherham Corporation he has always been regarded as one of its strong men, and is still very active in the affairs of the municipality. He is a Borough and West Riding Justice of the Peace. It is intended at an early date to give a complimentary dinner to Mr. Gummer in Leeds, to express the appreciation of the members of the Brassfounders' Association of the long and valuable service which he has given to the Association and the brass trade in general. It is expected that the trade will be well represented. The firm of Gummers, Limited, is known throughout the trade for their steam and water fittings, and the business has been built up to its present dimensions during the lifetime of the subject of this notice.

### Wills.

| | |
|---|---|
| TILEY, W., chairman of Tiley & Brown, Limited, engineers, etc. | £10,910 |
| KING, D. MacMillan, ironfounder, Possilpark | £22,155 |
| CUMMING, W., ironfounders' blacking manufacturer, of Glasgow | £17,612 |
| HARDY, W. H., principal of Crewdson, Hardy & Company, Limited, tube manufacturers | £44,526 |
| BROOK, E., engineer, of Ardencote, Norton Way, North Letchworth, patentee of gas producers, heating and annealing furnaces, etc. | £8,605 |
| OGLEY, W., of Rockley Road, Sheffield, senior partner in Ogley Bros. & Company, manufacturers of malleable tube fittings, of Sheffield | £4,302 |
| HENRY, J., of Grand Vue, Fairfax Road, Beeston Hill, Leeds, founder of the firm of Joseph Henry, Limited, ironfounders, Holbeck | £8,062 |
| SHENTON, J., of Cookley, near Kidderminster, founder and chairman of J. Shenton & Company, Limited, engineers and iron founders, of Great Bridge | £1,286 |

# The Cylinder Problem.*

By O. Smalley, M.I.Brit.F.

(*Continued from page* 151.)

## Metal.

The principal metallurgical defects of cylinder castings are low test figures, open grain, draws, porous patches, variations of grain in bore, shrink-holes, blow-holes, mechanically trapped foreign matter and cracks. It is not meant to imply that these defects are traced directly to the use of defective iron. The fact that they are common to land- and marine-engine cylinders rather suggests that cylinders as a class present similar difficulties of manufacture, and that the fundamentals of design, metal or organisation are not really understood. Owing to the wide scope of the paper it is impossible to give the detailed study that the subject demands, and the author's comments must be confined to the simple metallurgical principles necessary to a better understanding of both manufacture and design.

*Melting.*—As a melting furnace, the cupola is subject to constant criticism. Some cylinder manufacturers find it profitable to instal the more costly open-hearth melting equipment, whilst on the Continent and in America the electric furnace alone, or as a refining and super-heating unit in conjunction with the cupola, is finding wide favour.

The difficulties of the cupola resolve themselves into melting hot, control of the fluid life of the molten metal and of the ordinary chemical elements, viz., carbon, silicon, manganese, phosphorus, sulphur. Under scientific control, however, these difficulties are not insuperable, and as a commercial melting unit, the cupola will not be easily replaced under the present conditions of high cost of fuel and labour.

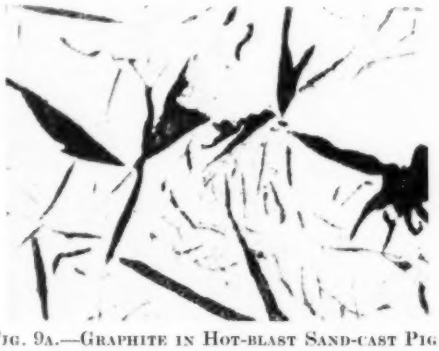


FIG. 9A.—GRAPHITE IN HOT-BLAST SAND-CAST PIG.

Cupola-melted grey iron is a material of unknown thermal stability. It is because of its anomalous behaviour in this respect that the selection of pig-iron on a basis of chemical composition has not altogether displaced the old-fashioned rule-of-thumb method of grading by fracture.

The texture or grain of cast-iron, which determines the physical properties, and on which the serviceable life of any cylinder depends, is controlled primarily by the graphite content, its physical form and mode of distribution. The influence of the element in this direction may be judged from the fact that in cylinder castings in general, the quantities range from 2 to 3.5 per cent. and may occupy as much as 10 per cent. of the total volume of the casting. Assuming a tiny worm-like formation, and being a soft friable and combustible substance of different co-efficient of expansion and contraction from the metal matrix, a slight variation in either the quantity or form exerts a profound influence on the serviceable quality of the iron. This is intensified by the graphite assuming various physical forms under different temperatures and pressures, its density ranging from 1.2 to 3.5 per cent., whilst its refractory and lubricating values are a function of temperature, time and rate of cooling.

* A Paper read before the Sheffield, Birmingham and Coventry Branches of the Institute of British Foundrymen and the North-East Coast Institution of Engineers and Shipbuilders.

These facts emphasise the supreme importance of precise control, if consistent production of sound castings is to be obtained. Unfortunately it is the substance over which, under ordinary conditions of manufacture, we have least control. Some eminent chemists assure us that it is a simple decomposition product of the carbide, and is directly under the influence of the other elements present, temperature and time. In ordinary practice this is erroneous, for it is quite common to obtain from two irons of similar chemical composition cast under identical conditions widely different mechanical properties, due mainly to the form and mode of distribution of the graphite.

The chemical composition of cast-iron in itself is of somewhat similar value to the chemical composition of a moulding sand or of any other complex structure. It indicates the principal elements present, without giving any idea of the chemical or physical constitution of the compounds formed or of their relation to one another. For this reason, the better practice in the preparation of cupola mixtures is that based upon chemical composition and the appearance of the fracture. This method, however, is unscientific, for whilst some claim to understand graphite and its behaviour in the manufacture of castings of any texture from the appearance of the fracture, the majority of metallurgists do not. To overcome this difficulty, the author prepares a special pig-iron melted at a controlled temperature and to a precise chemical composition, which is cast in chill moulds. This safeguards the quality of the iron and retains much of the carbon in solution, whilst the remainder is disseminated in a fine state of division.

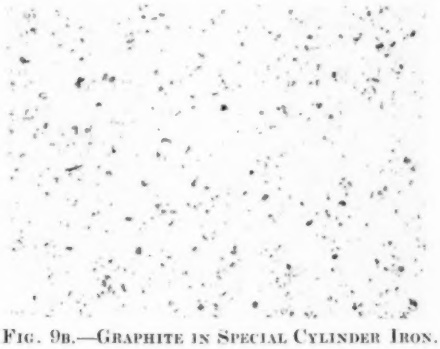


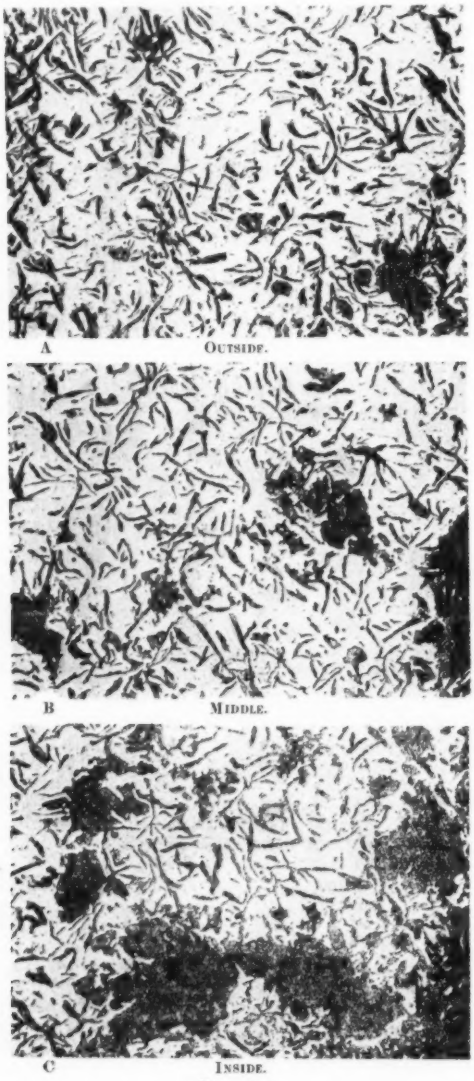
FIG. 9B.—GRAPHITE IN SPECIAL CYLINDER IRON.

Photomicrograph A, Fig. 9, shows the graphite of ordinary sand-cast pig made in a hot blast furnace, and B of the same figure the graphite of a specially prepared cylinder iron. Both irons have practically identical compositions with the exception of the total carbon content, which is 3.5 in A and 3.08 in B. The use of this special iron, for all practical purposes, solves the pig-iron problem and facilitates the preparation of cylinder mixtures from a basis of chemical composition alone.

*Cylinder Mixtures.*—Having established a control of the quality of pig-iron, the selection of a suitable chemical composition for any particular class of cylinder rests with the *service conditions required, our knowledge of the metallurgy of cast-iron and the design of the casting.*

*Service Conditions.*—The engineer does not give much practical assistance. His requirements are but vaguely expressed, and his design often evolved from accumulated practical engineering experience does not consider metallurgical principles. Taking, for example, the test bar, which is now engaging the attention of a committee of eminent metallurgists and foundrymen: within recent experience, it was common practice to cast a 1-in. square bar and break over 5 ft. support by means of a weight suspended at the middle. Rupture of this bar at once or over night, as might be demanded, would condemn the casting.

Crude as this method was, it laid the foundation of the present-day methods for the testing of cast-iron, which have advanced in detail only, and extended by the application of physical tests which have been found useful for other materials of construction, although serving a different purpose. For cylinder castings, for instance, the Brinell hardness test is frequently specified and cylinders are accepted or rejected on a certain hardness figure. Yet the Brinell test does not measure tenacity hardness as is generally understood; nor can a standard Brinell figure be used universally as a standard measure of the life of the cylinder. Similarly, the tensile and compression tests rarely measure the simple stress indicated, for if the graphite flakes happen to take a particular dimension or form, fracture occurs by



A OUTSIDE.

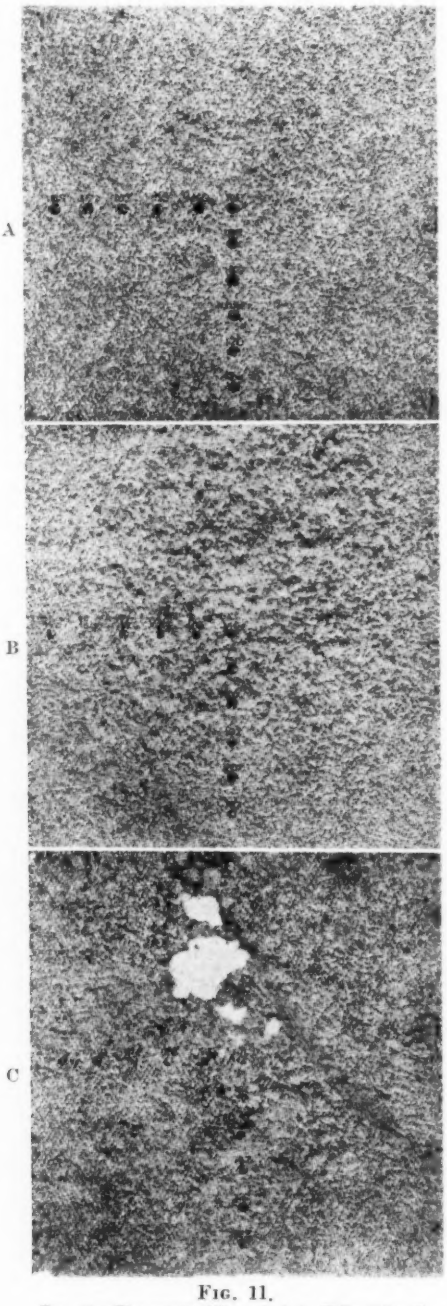
B MIDDLE.

C INSIDE.

FIG. 10.

shearing. Again, it is not uncommon to find that the cross-sectional area of the transverse bar does not correspond to the section of the casting. Such a bar can give little indication of the real strength of the casting.

The original idea of test bars in early history was to measure the quality of iron going into the casting and nothing more. They furnish valuable information of the conditions operating in melting and the temperature of pouring. They are certainly supposed to convey something more than this to the engineer, and it is not uncommon to see an otherwise good cylinder rejected on low test figures; yet when these are satisfactory, he guardedly reserves the right to reject on grain or water test, both of which are ambiguous and subject to personal prejudice in their decision. An instance of this may be cited in the rejection of nine locomotive cylinders. These were considered to be open and did not pass the water test satisfactorily. After transferring the patterns to another foundry, the results were unfortunately worse. To alleviate the situation, the contractors recalled the original cylinders, which this time not only passed the second water test, but after a light finishing out were held up as examples of close-grained cylinders to other manufacturers. Rejections of this nature, justified or unjustified, incur losses to both the foundry and machine shop,



A

B

C

FIG. 11.

FIG. 11.—The composition of A is T.C., 3.40; Si., 1.05; Mn., 0.65; P., 0.09; and S., 0.063 per cent. B is T.C., 3.27; Si., 1.15; Mn., 0.62; P., 1.54; and S., 0.086 per cent. C is T.C., 3.38; Si., 2.30; Mn., 0.60; P., 0.78; and S., 0.063 per cent.

and create an unwholesome atmosphere in the two departments.

*Open Grain.*—Fig. 10 represents a series of micrographs taken through the section of a cylinder that was rejected on account of open grain in the bore. The tensile, transverse and Brinell tests were to specification. This is obviously a metal defect resulting from the use of an iron too high in total carbon and silicon contents, and from too slow cooling.

Fig. 11 shows the effect of mass on the solidity

or texture and on the Brinell hardness of three irons made under similar conditions in ordinary sand moulds. The three photographs suffice to demonstrate "solidity" of cast iron as a function of chemical composition, and show that for ordinary sand castings the minimum section permissible to uniform solidity from a cylinder iron may range from 1 in. to 6 in., according to its "solidity penetrating power." Expressed in

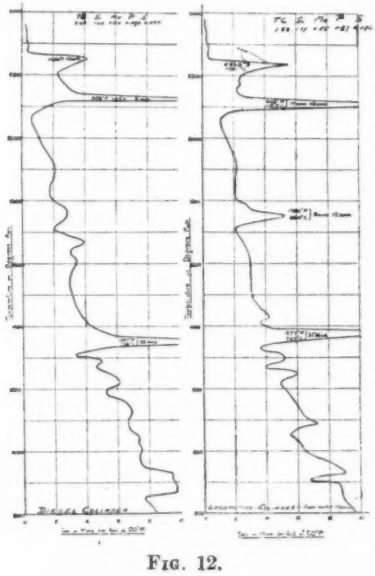


FIG. 12.

terms of actual strength, they show that by further increasing any section beyond the limits of the "solidity penetrating power" of the iron used, there is a corresponding decrease of strength. Assuming, for example, that a tensile figure of 15 tons is obtained from a cylinder iron whose solidity penetrating power is 2 in., at 4 in. this may fall to 9 tons; at 6 in., 3 tons or less. Yet it is not uncommon to meet with specifications of a chemical composition, without regard to either section or dimension of the casting.

This simple illustration is presented here to demonstrate that under ordinary conditions of manufacture of sand castings, weight and mass do not necessarily mean either increased strength or longer life in service. Heavy sections, bosses, large fillets and strengthening ribs not only increase the cost of manufacture and reduce the chance of the production of sound castings, but weaken the structure as a whole.

### Mechanism of Solidification of Cast-Iron.

The cooling curves taken from a Diesel-engine-cylinder iron and from an ordinary locomotive-cylinder iron, reproduced in Fig. 12, show the essential difference between these two irons on solidification to lie in their range of freezing temperatures. In the former solidification commences

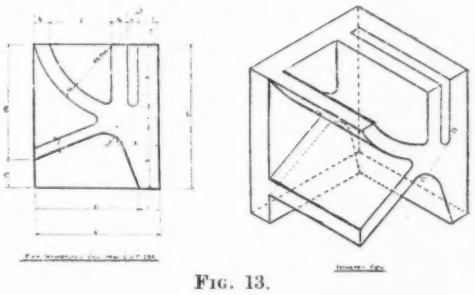
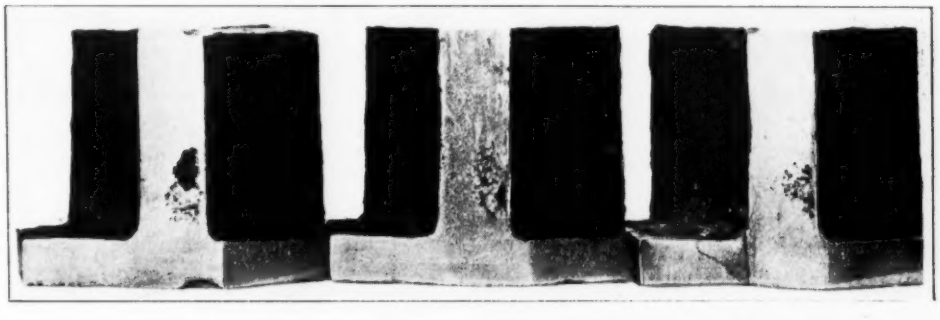


FIG. 13.

at approximately 1,240 deg. C., and is complete at 1,160 deg. C.; in the latter it commences at 1,231 deg. C. and continues to 935 deg. C., *i.e.*, the freezing range of the former is 80 deg. C. and of the latter 296 deg. C. There exists the same difference between the process of solidification as between mild steel and Admiralty gun-metal. Because of its long freezing point, ordinary cylinder iron thus presents the same defects of crystallisation and liquation as ordinary gun-metal, and consequently presents similar difficulties in the manufacture of solid castings.

To demonstrate the difference between these two irons in the manufacture of solid castings of varying sections, where ample opportunities exist for the manifestation of the ill-effects of differential freezing, the casting shown in Fig. 13 was designed. This represents a portion of a port of a cylinder that gave trouble in manufacture from "internal draws" at the heavy section. The sections range from ½ in. to 2½ in. The castings were made with the heavy section at the bottom and without risers, running from the bottom so

A B C



D E F

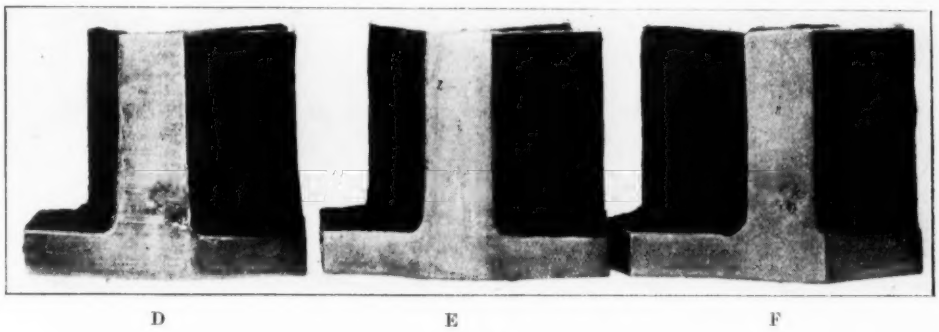


FIG. 14.

as to represent as faithfully as possible the actual conditions of freezing operating in complete cylinder castings.

Each casting was sectioned through AB, the position of drawing according to the isothermal lines of the casting.

In Fig. 14, A, B and C show the result obtained from three soft irons of the following chemical compositions:—

| | Total Carbon. | Silicon. | Manganese. | Phosphorus. | Sulphur. | Molybdenum. |
|---|---|---|---|---|---|---|
| A. .. | 3.27 | 2.20 | 0.72 | 0.91 | 0.096 | — |
| B. .. | 3.27 | 2.20 | 0.72 | 0.91 | 0.096 | 0.20 |
| C. .. | 3.34 | 2.50 | 0.56 | 1.83 | 0.044 | — |

D, E and F show the results obtained from three cylinder irons:—

| | | | | | | |
|---|---|---|---|---|---|---|
| D. .. | 3.41 | 1.41 | 0.60 | 0.90 | 0.072 | — |
| E. .. | 3.49 | 1.25 | 0.68 | 0.20 | 0.089 | — |
| F. .. | 3.51 | 1.10 | 0.68 | 0.53 | 0.085 | 0.25 |

These experiments show that the wider the freezing range and the softer the iron, the greater the

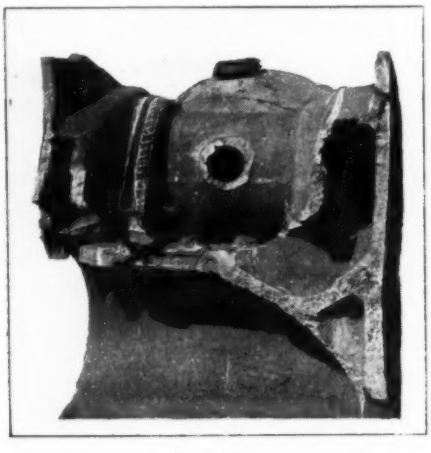


FIG. 15.

tendency to draw. B suggests that molybdenum is of value in reducing drawing of an iron of long freezing range, whilst C shows that by increasing the phosphorus to an abnormal figure so that excessive quantities of the low-melting-point phosphide predominate, drawing is slightly reduced.

D, E and F show an all-round improvement, whilst E, a low-silicon and low-phosphorus iron of high solidity penetrating power and short freezing range, is equally solid throughout. These results indicate the influence of chemical composition as a factor in eliminating the trouble of leaking ports. Other factors which also influence solidity are temperature of pouring, rate of cooling, and rate of running. This form of test piece could be applied to investigate each of these and to any design of cylinder giving trouble, modifying the form or sectional dimensions accordingly, instead of using the cylinder itself as an experiment. Such a test bar, incidentally, provides the engineer with direct information on the solidity of the various sections throughout his castings.

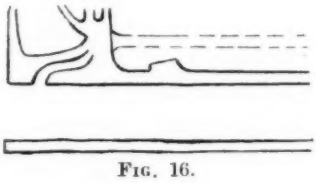


FIG. 16.

Fig. 15 shows a fracture through a defective port of a locomotive cylinder. At this position five sections, ranging from ½ in. to 1¼ in., conjoin. Comparative analyses from a solid and defective portion of this cylinder are given below:—

| | Total Carbon. | Silicon. | Manganese. | Sulphur. | Phosphorus. |
|---|---|---|---|---|---|
| Sound .. | 2.93 | 1.29 | 0.57 | 0.091 | 0.53 |
| Drawn Port | — | — | — | 0.176 | 0.17 |

Fig. 16 represents a diagrammatic section, and Fig. 17 a fracture through the port of this cylinder. This is even more complicated than the standard section first considered (Fig. 13), and apart from the ill-effects of selective crystallisation and liquation, such an arrangement of cores will act as scum traps for the oxide, slag and dirt from the mould accumulating on the surface of the rising metal. Chemical analysis is not the best means to demonstrate this point, although it will be observed that the sulphur content at the draw is 0.176 against 0.091 obtained from a sound portion of the cylinder. Apart from functioning as scavengers, however, cores presenting little or no cooling surface prevent free dissipation of heat from the solidifying iron. Conservation of heat in this way is equivalent to mass influence, and for this reason alone the design of the port is a common cause of sponginess and general unsoundness.

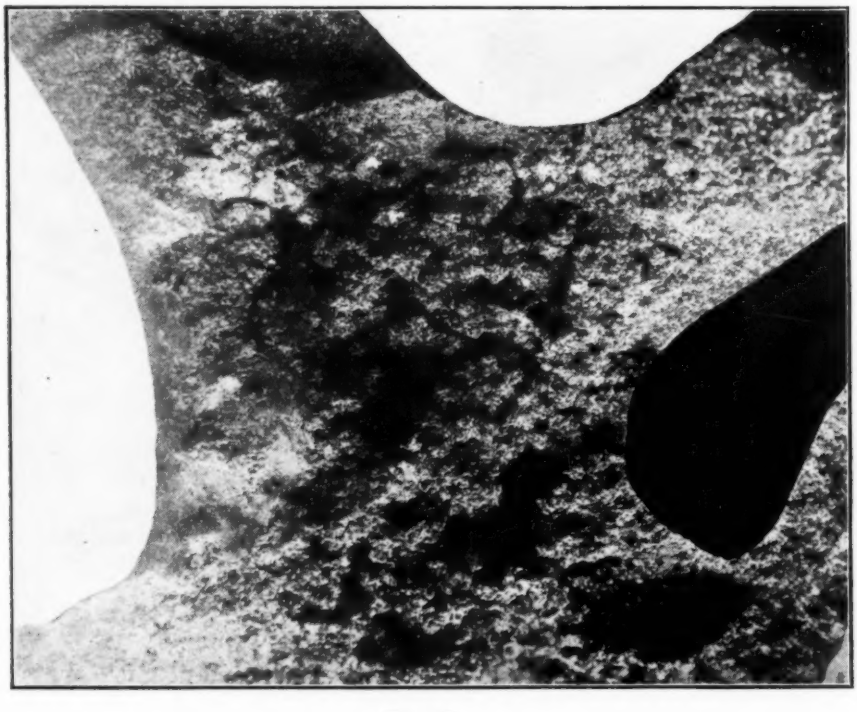


FIG. 17.

Any form of design, therefore, that presents these features is not only bad for the foundryman, increasing his difficulty and also his cost of manufacture, but produces finished castings that will always be a source of trouble to the engineer.

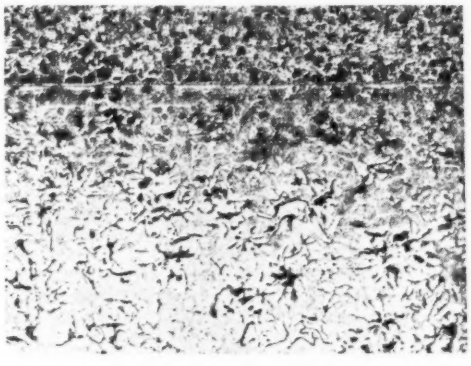


FIG. 18.

Fig. 18 shows a section through a port of a cylinder made by a recently patented process of casting on suitably formed steel sheet. The efficiency of the weld is apparent from the photograph, the steel could be pulled away readily from the casting. The objections against the general adoption of this process are the uncertainty of attachment, blow-holes and mechanical defects from misplacement. It is a palliative, not a remedy of "draws" in ports of cylinder castings.

Fig. 19 shows a section through the exhaust port of a 14-ton marine-engine steam cylinder of simple form, which gave considerable trouble. Here three sections ranging from 1½ in. to 2¼ in. merge into a mass of metal 3¾ in. across, whilst the main core at this position running almost to a point presents little or no cooling surface. The defect encountered was a draw at the heavy section, and in one port 170 lb. of cement were pumped in ineffectively. Permission to modify the design was not granted, but the alteration shown by Fig. 20, which safeguarded the cylinder against rejection under water test and foundry losses, by no means ensured sound metal at this position; and owing to the form of the port and the metal contracting on the chill, the removal of the sections was both risky and costly. Fig. 21 shows another marine-engine cylinder which presented similar difficulties. Fig. 22 shows the change in design permitted to ensure a more uniform distribution of the heat. A sound casting

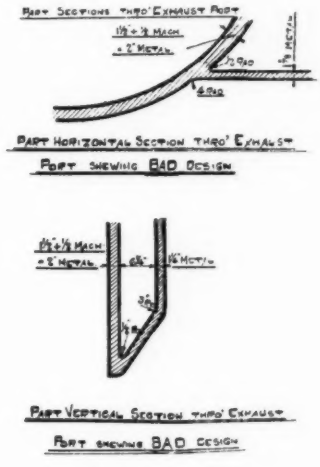

PART SECTIONS THRO' EXHAUST PORT
PART HORIZONTAL SECTION THRO' EXHAUST PORT SHEWING BAD DESIGN
PART VERTICAL SECTION THRO' EXHAUST PORT SHEWING BAD DESIGN

FIG. 19.

was obtained without radically altering the design or dimensions.

*(To be continued.)*

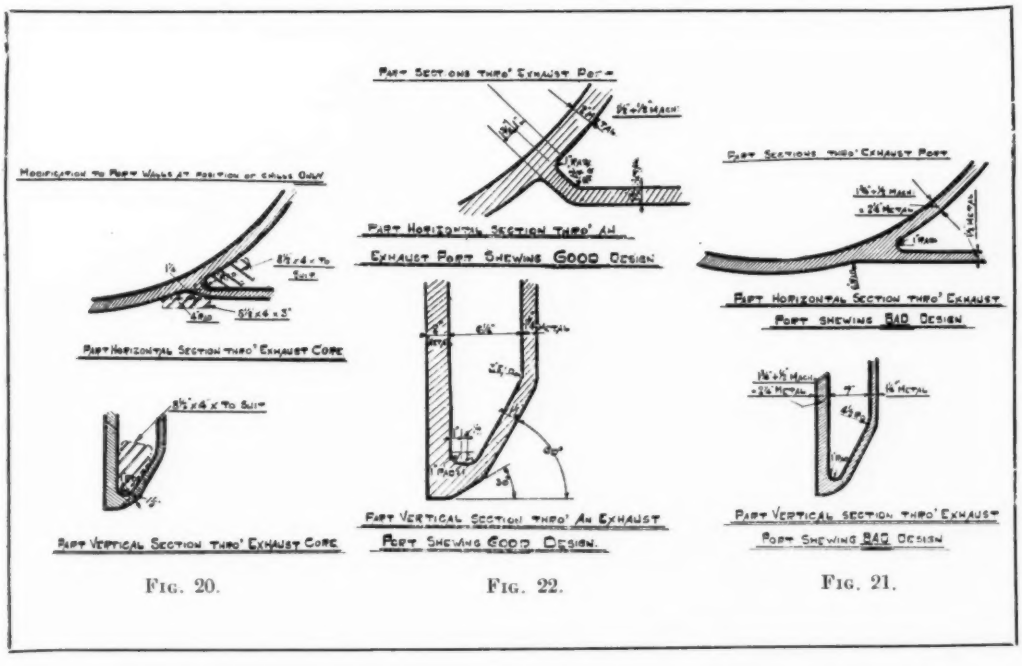

MODIFICATION TO PORT WALLS AT POSITION OF CHILL ONLY
PART HORIZONTAL SECTION THRO' EXHAUST CORE
PART VERTICAL SECTION THRO' EXHAUST CORE
PART SECTIONS THRO' EXHAUST PORT
PART HORIZONTAL SECTION THRO' AN EXHAUST PORT SHEWING GOOD DESIGN
PART VERTICAL SECTION THRO' AN EXHAUST PORT SHEWING GOOD DESIGN
PART SECTIONS THRO' EXHAUST PORT
PART HORIZONTAL SECTION THRO' EXHAUST PORT SHEWING BAD DESIGN
PART VERTICAL SECTION THRO' EXHAUST PORT SHEWING BAD DESIGN

FIG. 20. FIG. 22. FIG. 21.

## Institution of Mining and Metallurgy.

The gold medal of the Institution of Mining and Metallurgy (the premier distinction within the gift of the Institution) has been awarded conjointly to Mr. Herbert William Gepp and Mr. Gilbert Rigg, in recognition of their joint and individual services in the advancement of metallurgical science and practice, with special reference to their achievements in the treatment of complex sulphide ores, and in the development of the electrolytic process for the production of zinc in the Commonwealth of Australia.

**British Empire Exhibition (1924).**—The British Empire Exhibition have now issued a "Handbook of General Information," giving a fuller and more comprehensive account of its various sections than has yet been published, also information about the site, size, accessibility, lay-out, etc., of the exhibition, with a plan of the grounds and a map of London, showing railway communication, etc. An up-to-date list of exhibitors (U.K. Section) has also been published

# Discussion on Dr. Barclay's Paper on the Practical Value of Modern Non-Ferrous Alloys.*

MR. PRIMROSE, in opening the discussion, remarked that Dr. Barclay emphasised very strongly the importance of foundrymen knowing the purpose for which castings were going to be used, but it was equally important that others should realise the difficulties the foundry workers had to meet and not make unreasonable demands of them.

Dealing with the question of electric metals he said that a little brass introduced into the pure copper was sometimes thought sufficient to meet the requirements. It kept up the strength and very often reduced the electrical conductivity and engineers were anxious to retain not so much the strength of the metal as its high conductivity.

### Admiralty Gunmetal.

The lecturer had remarked that Admiralty gunmetal was not of special importance, and there he joined issue with him. Together with his brother he had worked on Admiralty gunmetal for many years, and even yet did not know all about it. It was a commonly-used alloy, and possessed many wonderful qualities when it had been given suitable heat treatment. When the constituent metals were put into the crucible care should be taken that there was no overheating, because if the alloy was overheated the ill-effect would not easily be eliminated. It was important not to add too much tin. There was an impression that because tin was an expensive metal it must be a good one. That was not so; it was liable to cause weeping, which led to trouble. If the tin was cut down just a little, keeping still within the Admiralty specification with 9.5 instead of 10 per cent., a better casting could be obtained. Apart from the fact that the cost was less, they did not get the weeping if the metal had to stand hydraulic pressure. Even when weeping was noticeable his advice was not to scrap the metal because it had been found that a simple annealing dissolved the eutectoid. It was not necessary to heat the casting to a temperature that would melt this constituent, and experiment showed that 700 deg. C. was the best temperature for that, the harmful constituents being dissolved. It gave a slightly higher tensile strength to the product and increased the properties such as ductility, which were useful in any casting that had to stand hydraulic pressure. It would yield a little before it would break. The interlacing structure in gunmetal was one which was very easy to attain provided the melting and casting operation was performed at the proper temperature.

### Slip Ring Castings.

MR. JOLLEY said he was pleased that they were now getting to the stage when it was becoming general knowledge that the foundryman and engineer must come close together, and that the former should get to know what his product was to be used for before it was made. It would be an advantage if both craftsmen could get together and thrash out their respective views before a casting was made scrap. With regard to slip-rings, Dr. Barclay had spoken about getting the metal solid and homogeneous on the outside, but was there any specific method by which that could be attained? What was required was a good, strong ductile metal on the inside to allow for the setting on or shrinking on, and at the same time a good solid close-grained metal on the outside to take the wear of the brushes.

MR. HILTON MILLS said they were indebted to Dr. Barclay for so constantly emphasising the fact that the foundryman, no matter what class of material he was producing, should have a clear idea of the conditions the casting was expected to withstand. That was a point which applied to every class of foundry work.

With regard to annealing he knew Mr. Primrose had great faith in that operation for saving castings which failed through weeping under pressure test, but if a casting was porous he did not see how it could be improved by annealing. Mr. Primrose and other people had, however, accomplished it and therefore it must be taken as a fact even though it could not be explained.

MR. TIMMINS agreed with Dr. Barclay that if founders knew what the real conditions were they would be in a better position to supply a suitable article. He did not think it was desirable to call in the engineer and draughtsman; they were best out of the foundry altogether. Quite recently he was referred to in connection with a complaint that a casting was not of the desired specification, and he found it was being used for a purpose quite different from the original. He asked the lecturer why was it that people who at one time preferred the ordinary phosphor-bronze propeller-boss now used steel? Since seeing the figures given by Dr. Barclay he wondered whether it was economy. Additionally he asked for the temperature which one should use for the purpose of annealing phosphor bronze?

MR. MAKEMSON said it would be interesting to know the relative conductivity that could be obtained with copper castings. They all knew how important it was when employing copper for electrical purposes to use electrolytic copper because of its very small quantity of impurity which latter lowers the conductivity considerably. Could the Doctor say what degree of purity could be obtained with copper castings and how the conductivity of such castings was related to that of electrolytic copper.

MR. KEY asked whether the lecturer had met with any method of controlling the melting temperature. In the foundry a great deal depended on the skill of the man who was melting, and the question of temperature was the main factor in the great proportion of cases they had to investigate when things had gone wrong. Much of the trouble was due to overheating the metal, and as far as he knew, a man could only measure temperature by his experience or by eye. For quite a long time they cast everything with a pyrometer and, although they were pouring at what they knew as the correct casting temperature, still they had bad results. He once asked a furnace worker, "When are you going to get this pot out?" He replied, "It will be ready soon," whereas it had been ready half an hour before.

A founder could really only work according to his eyes; there were no satisfactory means of measuring whether the material was hot enough or overheated. Were there any definite means whereby the furnace could be given some definite guide as to when his material was ready for teeming.

### THE AUTHOR'S REPLY.

DR. BARCLAY remarked that he would be very sorry to underrate the classical work of Mr. Primrose and his brother on the subject of gunmetal. Replying to Mr. Jolley, Dr. Barclay expressed the opinion that it was desirable for the founder, the engineer and the electrical designer to get more closely into touch with each other. Slip-rings for electrical machines were often made of far heavier sections than was necessary. After the founder had done what he could in producing the metal free from impurity and casting at the right temperature, further progress could be made only by making lighter the heavier sections. With a deep section there must be sufficient strength on the inside to stand the shrinkage stress, and it is difficult at the same time to secure a close grain on the outside. If Mr. Jolley would look up some of the American and Continental designs he would see that it is common practice to make the ring in two sections—a centre portion shrunk on to the shaft with a thin ring shrunk on to it to carry the electric current.

### Steel Propeller Bosses.

The lecturer said he agreed with Mr. Timmins in regard to the relationship to be preserved between the engineer and the foundry; engineers were apt to use a given alloy for entirely different purposes without informing the founder and

* This Paper appeared in the issue of THE FOUNDRY TRADE JOURNAL of Jan. 31, 1924.

expecting it to possess at the same time all its various qualities in a maximum degree. With regard to the use of steel for the propeller boss, he believed it was right to suggest that economy was the reason for employing it. The annealing of the phosphor bronze was not done to the same extent as with gunmetal, but for some purposes it was advantageous to anneal, which process should be conducted at a temperature of about 700 deg. C.

On the question of copper castings for electrical purposes, he mentioned that the standard of electrical conductivity was not absolute but relative, and it was possible to have copper with a conductivity of more than 100 per cent. He had read of copper castings having a conductivity as high as 96 per cent., but in his own experience had never found them higher than 87 per cent., but if a conductivity of 80 per cent. could be realised for all ordinary work it was good enough.

MR. KEY raised the question of the use of the pyrometer in the foundry. His experience up to the present was that in ordinary practical foundry work all the metal could not be controlled by a pyrometer. It was astonishing what little progress had been made in that direction, and he would depend on the eye of the skilled man more than a pyrometer. The instrument wanted watching very closely and ought to be calibrated very frequently.

**Vote of Thanks.**

MR. PRIMROSE, in moving a vote of thanks to the author, said it was an admirable thing that there should be one non-ferrous Paper each session.

In reply to Mr. Mills, he would like to add that if there were actual holes in the casting annealing would not remove them. The annealing was adopted in order to remove the harmful eutectoid which shrank away from the crystals leaving the intergranular porosity.

MR. MASTERS seconded. He said he was not a non-ferrous worker, but touching on the question of the electrolytic copper it was their experience some time ago to make castings of copper commutator ends, and they were very successful. The conductivity was above 90 per cent.; as a matter of fact, castings below 90 per cent. conductivity were rejected. The agent used was boron, and it was used according to a specification supplied to them. A man was sent up to see the work was done properly, but whether it was by accident or not every casting he produced was a bad one. When it was left to themselves they made them all right. They used the pyrometer and found the proper casting temperature was 1,300 deg. F.

The vote of thanks was carried with acclamation.

## Brittleness in Metal.

A discussion on the subject of "Brittleness" took place at a recent meeting of the Birmingham Metallurgical Society. Mr. H. B. Jacks (President) was in the chair. The discussion was opened by the reading of a communication from Mr. W. R. Barclay, of Messrs. H. Wiggin & Company, Limited.

A clearer idea of the limits within which the term "brittleness" should be used in metallurgy was indicated by MR. BARCLAY as the primary and probably the most useful function of such a discussion. The word, he said, was sometimes used—particularly by consumers—when material was simply "hard-worked." True, in such cases the ductility was low, but the term "brittleness" ought not to be used. Dealing with nickel and nickel alloys, he sometimes came across striking examples of true brittleness where the metal would behave almost like glass. This seemed to be usually associated with weakness of the crystal boundaries and was due to a variety of causes. Burning, for example, would usually take effect first at crystal boundaries, whilst oxygen and sulphur under certain conditions would enter the material and destroy the cohesion between the crystal grains. In nickel this phenomenon was particularly noticeable through the action of carbon, and was usually accompanied by a separation of graphite. Sometimes they came across cases where this trouble happened with a relatively low carbon content, and yet might not happen with a carbon content above what was ordinarily considered a safe limit. In the latter event the carbide existing in the material evidently was not decomposed, but the exact condition necessary either to avoid or to cause decomposition were by no means clearly understood.

The main cause of brittleness in a rolled sheet or drawn wire was probably impurities. Casting conditions gave rise to wide variations in the behaviour of alloys of exactly the same composition, but here the term "brittleness" could hardly be applied legitimately. Fire-cracking, cracking of edges during rolling, etc., could not legitimately be described as illustrating brittleness, being often due to local conditions which had little to do with the intrinsic qualities of the alloy. Should not the term brittleness—the author asked—be confined to phenomena connected with the lack of cohesion between crystals? There could be no question of the extreme value of the Izod impact test, or the notched-bar test. But for sheet metals there seemed to be no real alternative to the bend test. This was extremely valuable, particularly to the experimentalist himself, for he could instinctively realise the quality of the metal when trying the test for himself. The difficulty arose in translating the test into numerical values, but fortunately some machines recently developed gave much promise of usefulness in this field. He did not think the ordinary tensile tests gave much real information as to brittleness.

DR. LESLIE AITCHISON, after reading Mr. Barclay's communication, said brittleness and toughness, after all, were but different degrees of the same property. In ordinary practice a piece of metal which would bend through a large angle without developing any fracture was said to be tough. If it broke at a small angle it was described as being brittle. In tensile testing, low elongation and reduction of area and a fracture which was flaky and non-fibrous caused a material to be called brittle. Brittleness was said to be the cause when an engine component broke with a fairly short fracture.

A steel with a low impact value was customarily called brittle, and other steels tough. If the core of a case-hardened article, when broken, appeared bright and flaky it was said to be brittle; if the fracture was grey and fibrous the material was said to be tough. In this case there must be something wrong with the use of the two terms. When two pieces of similar material, the one not carburised and the other carburised, were subjected to the notched-bar test the non-carburised piece might give about 70 ft.-lbs. and the carburised about 2 ft.-lbs., although the former showed a fracture said to indicate brittleness and the latter a fracture associated with toughness. Yet the material in both cases was in the same condition and was doing the same job.

It was essential to distinguish between brittleness and lack of ductility, and, on the other hand, between toughness and ample ductility. If those things were the same, one should cease to talk about toughness and brittleness and should simply refer to the phenomena in terms of ductility. But that could not be done, seeing that there actually was a difference between ductility and toughness. Some distinction might be necessary between what might be called "intrinsic brittleness" and "mass brittleness." Intrinsic brittleness or toughness was that possessed by the individual crystals which made up the material. It seemed that till one could observe the behaviour of these single crystals one would not be able to think accurately of what toughness and brittleness might be, because all one's ideas on the subject were rendered obscure by what had just been called "mass brittleness." Intercrystalline brittleness, due to special casting conditions, burning and the general effect of impurities, were not properties of the metal as metal. The speaker rather ventured to hope that the metals themselves would be found to have a very high intrinsic toughness. If one could get down to the properties of the crystal grain one would be able to fill up the blank which so far had upset all one's observations. With regard to engineering failures, he was not at all sure that in very many cases which were put down to brittleness or lack of toughness, the explanation would really hold good. Where fracture occurred in a tension member of an engineering structure a large amount of distortion must have preceded it, and toughness had nothing to do with the ability of a metal to distort. Fatigue failures, of course, were excluded from such a consideration.

THE HOME SECRETARY has rescinded the Order of May 21, 1913, (*b*) relating to the night employment of male young persons in those parts of factories in which reverberatory or regenerative furnaces are used, and has directed that the special exception by which a male young person may be employed during the night in certain factories shall extend, so far as regards young persons of the age of 16 years and upwards, to parts of other factories in which reverberatory or regenerative furnaces are used in connection with (i) smelting of ores, (ii) metal rolling, (iii) forges, or (iv) manufacture of metal tubes or rods, and are necessarily kept in operation day and night in order to avoid waste of material and fuel, subject to certain conditions.

XUM

# Some Necessary Adjustments Between the Foundry and Drawing Office.*

By E. Ronceray, M.I.Mech.E., Hon. M.I.Brit.F., Paris.

[THE BRANCH-PRESIDENT (Mr. J. B. Johnson), before calling upon M. Ronceray to give his lecture, expressed his pleasure at seeing so large an attendance in honour of their distinguished visitor. There was no man in the ironfoundry world, he said, whose name was better known. From time to time M. Ronceray had provided them with original ideas on certain aspects of their industry, from which they had derived great benefit. The results of his researches had been freely placed at their disposal. They were also honoured by the presence of Sir William Mills, the pioneer of aluminium founding in this country. He would ask Sir William to supplement the welcome which he had expressed to M. Ronceray.

SIR WILLIAM MILLS said those who had had experience of aluminium casting would appreciate his difficulties as the pioneer of the industry in England. His difficulty was with the men, who wanted to do the work in exactly the same way as though they were dealing with iron or brass. Some of the patterns he received were almost impossible to cast, and he was told by many steel casters that they could not be done. But they made the castings somehow in aluminium. In some instances he asked for a slight modification in the pattern, and occasionally his request was acceded to, but in most cases he was told that if he did not cast what had been designed the orders would be placed elsewhere. During the war his firm produced nearly all the Puma engine castings, which amounted to a very large number, and they had great success with them. The explanation was that Mr. Siddeley used to submit the tracing and ask what alterations they desired to make, so that there should be no trouble after the castings were made. That was a practice that might very well be generally followed.]

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The title refers to a very broad subject, and it is impossible to survey it completely in the course of one Paper. However, there are a few points that can be usefully discussed for the common interest of both foundryman and engineer.

Their respective claims tend to show that they are not quite satisfied with each other. The foundryman maintains that the engineer, who has no knowledge of the foundry trade, designs unnecessarily complicated shapes, badly proportioned, difficult to turn out in sound and strong castings at a reasonable price.

The engineer complains that the castings he is supplied with are unsound, full of blow-holes or porosities, rough in appearance and expensive.

Both are right to a great extent, and it is a curious fact that when an attempt is made to adjust the differences it is very difficult to bring either of them to proceed from the general to the particular; in other words, both of them maintain that the other is wrong, but are unable to say how and where, and to make definite suggestions for bringing about improvement.

The following is an attempt to make a small step in the right direction. It is the result of a few years' study of other peoples' researches, also of personal deductions and experiments of a modest engineer who has become a modest foundryman. It is a great pleasure to him to bring the earliest communication of his work to the Institute of British Foundrymen in Birmingham where he has so many friends, and where he delivered two years ago a lecture which started the ball rolling for the international study of new methods of testing cast iron and where he had the honour of being elected honorary member of your great Institute.

### The Requirements of the Engineer.

In short, the engineer wants an abundant supply of sound and strong castings, of good appearance at a reasonable price. To give this to the engineer the foundryman requires from him a good design, simple forms, equal thicknesses.

It is when the details are worked out that the differences start, the exact requirements not being defined. The common knowledge necessary to both engineer and foundryman will probably be scheduled some day, and the author is doing his utmost to start the work in the Paris Foundry High School of which he has the honour to be the Director of Studies.

But this work, similar to what Monge did in laying down the rules of descriptive geometry from the information he obtained in studying the practice of the builders of past centuries, will take a long time.

To be satisfactory, a casting must *primarily* be *sound*. It is rather easy to make it of strong iron, but it is useless if it is not sound. On the other hand, being sound and made of strong iron, it is useless if there are *internal strains* that bring some parts of it near the breaking point. So there are three main points to consider:—Internal strains, soundness and strength.

### Internal Strains.

It is a great pity that there is up to now no practical way to detect internal strains in castings. There are perhaps hopes that this will come one day; however, this day is not yet in view. But there are at our disposal several ways to reduce internal strains to a minimum, some of them by the engineer, others by the foundryman.

To reduce strains the engineer can design his castings with thicknesses as regular as possible, avoiding abrupt changes. He can also, when he requires different thicknesses, have the castings cast even and machined out to get reduced thicknesses where he wants them.

In view of the same results, the foundryman can put his runners so as to pour the metal in the thinnest parts, thus reducing their tendency to cool quicker than the thicker parts; to fill the same purpose, he can put chills or denseners against the thick parts. He can also heat-treat them after pouring, or cool them slowly from a given temperature similar to the American chilled wheels which are remarkably strong.

He can also use when there are enclosed cores a special material, resin for instance, for avoiding undue resistance to shrinkage or else break the moulds and cores shortly after pouring.

But the engineer then must be expected to understand that these processes entail an increase in price. He must accept it and not try to cut down the cost price by starving the foundryman, but rather by judicious design and collaboration. He must also accept or even suggest chills or denseners at certain points of his castings providing they can be machined.

### Soundness.

Unless they are very apparent defects the unsoundness of a casting is not generally detected until machining has brought it to light. Sometimes it is only found after complete finishing when a pressure test is made, and sometimes it is never found except when the casting is broken, either in service or when it is withdrawn from service.

### The Real Object of Making Castings without Feeding Heads.

Unsoundness of a casting in many cases condemns it, especially when it occurs in a vital part. Where it occurs it renders useless the attempt that has been made to use a strong metal. It may be accepted only at unimportant points, and always casts suspicion on the other parts of the casting when it is discovered. The author has devoted much time to and has made some personal researches on this point, and his conclusion is that, in most cases, unsoundness in castings is more due to gas effect arising from insufficient permeability of sand rather than to the so-called draws, especially with iron castings. Previous Papers by the author on related subjects raised

* A Paper presented to the Birmingham Branch of the Institute of British Foundrymen, Mr. J. B. Johnson presiding.

a good amount of interest even in Birmingham, where they have been discussed. Unfortunately, the question has not always been understood from the right point of view.

When advocating pouring without feeding heads it was not thought to promote any improvements by simply doing away with feeding heads or risers, the point being that the common use of feeding heads is almost always to correct a defect of the mould unknown to the moulder. In other words, it is supposed to feed a draw in a casting while in fact it fills quite another purpose. It masks the real trouble and provokes the use of wrong methods of curing it. Those interested may perhaps have read the author's Papers in the "Proceedings" of the Institute or in the FOUNDRY TRADE JOURNAL.

### "Effet Leonard."

M. Joseph Leonard, Past-President of the Liège Foundrymen's Association, has thrown light on some very interesting points in several Papers and lectures. The defects mentioned are due to an intense production of gases at certain insufficiently permeable points of moulds which are highly heated by hot metal with the result that these gases, not being able to escape through sand, find their way through metal in leaving various sorts of defects: black spots, blowholes, porosities, etc. The author has called this phenomenon "Effet Leonard," and it is quite typical though very little known. As a rule, it is misunderstood, and taken as a draw. These conditions are shown in Fig. 3.

Finding black spots in motor-cycle cylinders of design shown in Fig. 4, M. Leonard thought they were due to gas effect of the type mentioned. To prove it, he used at the point under consideration, core sand, and took special care to vent it, when the trouble disappeared. He reproduced the trouble in a specially-designed casting of the shape shown in Fig. 2. The black spots appeared in the congested and unvented place and not in other places. It is easy to reproduce them or to avoid them by proper means.

There are very often faulty designs which could be improved by slight alterations resulting in increasing considerably the chances of getting a better casting.

For instance, a lathe foot or a bed-plate (Fig. 10) which has a round flange (A) can be altered with great advantage to that shown at B.

On loco.-cylinders bosses should be avoided where there are bolt holes (Fig. 9). When there is a loose boss on the side of a frame the design should be altered to make it one piece with the pattern, as a loose piece is always liable to move.

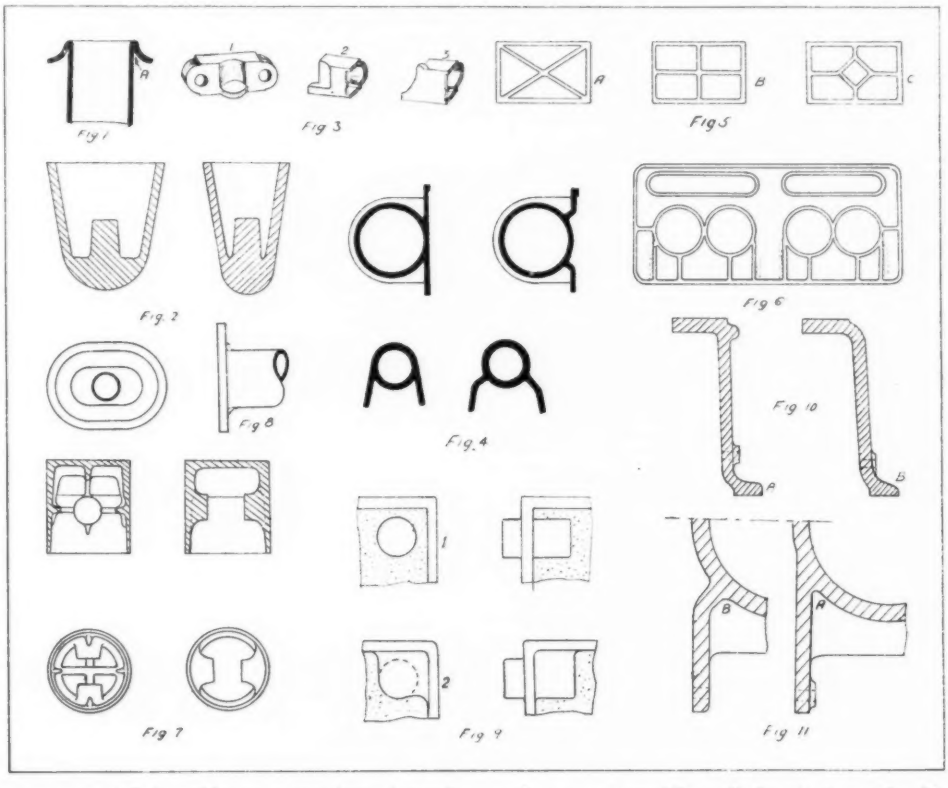
### Definite Examples.

The author has fully demonstrated by numerous experiments how many defects that are usually attributed to other causes can be very simply cured by special attention paid to ramming and venting of restricted points. The troubles reappear again as soon as this special *attention* is no longer practised.

(A few samples were shown at this point.)

The conclusion of the above will be that the designer will do well to avoid such restricted points in his design. For instance, in a locomotive cylinder, instead of having a sharp-nosed piece of sand, shown at A, Figs. 1 and 11, the design should be altered to flatten it as at B, Fig. 11.

In a bed-plate or a surface-plate, ribs instead of meeting at an acute angle as at A, Fig. 5, the design should be modified to give that shown at B or C, Fig. 5.




In an automobile cylinder it is preferable to eliminate the acute angles rather in order to suppress the thin angle of sand, as shown in Fig. 6. Again, in an automobile piston instead of thin ribs meeting at different angles it is better to cut off all the ribs and round the corners, as shown in Fig. 7.

In castings having thin cores it is sometimes more advantageous to avoid such cores as they are strongly heated and difficult properly to vent.

When there are angles, as in Fig. 8, formed by a flange at the end of pipe, it is always advisable to round the corners and to form them with leather fillets rather than to let the rounding be at the discretion of the workman.

When there is an enclosed core the designer must provide for openings, if possible, at several places. When the moulding of a casting with such an enclosed core is to be made one must, when ever possible, provide the core print at the top, as it is always easier to protect it, and the escape of gases is much easier by the top of the mould than by the bottom.

The fact is now well-established, that for many metals there is no need for avoiding draws by special feeding, and above all, there is no need

of churning or pumping, especially for the ordinary thicknesses. That, as will be seen later, the engineer must try to conform to. A proper design and correct moulding are all that is necessary, and if such a course is followed there are more chances to get a sound casting than by processes involving the blind use of a remedy to poor design and poor work.

### Other Factors.

Metal is not always clean when in the ladle, and attempts to clean it before pouring are unsuccessful in skimming every particle of slag. Slag in a mould introduces blow-holes where it stops, so that steps must be taken to prevent its entrance into the mould as much as possible.

There is always the necessity of avoiding the introduction of air with metal in the mould, otherwise what the author called "Custer effect" will take place. Custer has proved that when air is entering in a mould with sulphurous iron a reaction takes place which produces $SO_2$ (sulphur dioxide), causing blow-holes especially when the metal is not very hot.

### The Importance of Runners.

On the other hand, speed of pouring must be regulated according to different cases. There are many ways of taking care of these necessities. Plug pouring is one of them. It is rather a common practice in this country. The use of tinned strainers is another one, and is very convenient on repetition work where the thickness of the strainer can be selected by experiment. These strainers and strainer cores used in America are satisfactory; however, the author prefers what he has called the "filter cores." They are simple discs of core sand, about ½ in. thickness, in which a few holes about ¼ in. dia. are provided. These cores are simply laid down in the mouth of the runner with the cover and can be seen by the foreman. If the casting is a heavy one, several of these filters are used, one on each of the several runners fed by same basin. It is recommended to cover each of the filter cores with a disc of strong paper.

When the metal is poured the paper prevents the first drop, which may be slag, entering the mould. The metal fills the basin, slag rising to the top. The paper burns and the filling of the mould proceeds through the small holes of filter cores. No air can be drawn into the mould, thus avoiding "Custer effect." Of course, the metal must be very hot to use such a process, and this is a good help towards a sound casting.

Too much care cannot be taken to provide a clean runner. This point is very important and is rarely considered sufficiently carefully. Special attention is paid to the mould and much less to the runner, which, however, is the more important. The gates and runners must be exceedingly clean and special attention must be paid to avoid their scabbing and washing, and a stronger and more permeable sand must be used for this purpose. The filter cores, followed by large runners, go a long way towards the avoiding of sand washing as the speed of metal stream is reduced.

Whenever possible, the gating must be so made that the metal flows down in a well where the first metal is accumulated. The first metal protects the sand and prevents washing.

The design and patterns must be made so that whenever possible the machined parts are cast down and when a machined part is at the top of a mould it is always safe to leave at least ½ in. machining allowance. The reason is that particles of sand and blacking which may be washed up by the iron, and little drops of slag are always collecting at the top, where they are liable to make dirt and provoke blow-holes.

### Strength of Iron.

Cast iron being the most commonly used material in engineering and the most affected by improper design will only be considered. In a written communication on Mr. J. Cameron's Paper* on Semi-steel, the author showed a graph representing Keep's curves as they appear in his book, "Cast Iron," with the only difference that the origin of ordinates is brought to zero, which makes it more intelligible than the graph of Keep, which started at 160. These experiments were suggested, it is thought, by the work of Professor Thomas Turner, who made the first researches on the influence of silicon on cast iron.

Though rather old now, Keep's curves are very interesting, and it is not thought that all useful conclusions have been drawn from them. On careful examination it will be seen that under the best conditions for each case, the strength of cast iron diminishes very quickly as the thickness increases; in other words, the thinner the casting, the stronger it is, or what is equivalent metallurgically, the quicker its cooling speed, the stronger it is. Transverse strength passes from 440 lbs. for ½ in. thickness to 260 at 1½ in. and 200 at 4 in., which means that a ½-in. bar is 2.2 times stronger per unit of weight than a 4-in. one (under the best conditions).

The first conclusion is that engineers must design their machines with thin walls instead of thick ones. When compelled to use thick walls foundrymen will know that by speeding up the cooling, for instance, by chills, they will increase the strength.

It is common knowledge that the lower silicon percentages would give white iron in thin sections. If, at the same time, it is realised that the strength of higher percentage silicon irons are the strongest for thin sections, then foundrymen will insist upon high percentages of silicon for such castings; 2.00 to 3.00 per cent. is adequate, as it will at the same time give softness and strength.

On examining the curves further, a knot between 1 in. and 2 in. is noticed, which implies that at 1½ in. thickness all percentages of silicon give about the same strength. Consequently, there can be no inconvenience by using in the foundry the same quality of metal for all thicknesses of metal up to what corresponds to a 1½-in. bar. Above that, the strength increases slightly when silicon diminishes for a 4-in. bar, there being a difference of about 20 per cent. between the 1.0 and 3 per cent. silicon iron, but obviously chills will help, and consequently one must be prepared to use them extensively when dealing with thick walls.

### Estimating the Strength of Cast Iron.

Every country seems to have its different ideas, and while the British Committee adheres to the separately cast test-piece, other countries prefer the resolution of International Paris Congress, which have been voted unanimously:—

"That the International Congress of Foundrymen, assembled in Paris, recommends that the testing of cast iron be differentiated into the testing of the quality of the iron entering the castings, from the testing of the quality of the castings themselves.

"That it is recognised that *in no case* will the testing of the quality of the iron give reliable information as to the quality of the castings made with it.

"That a joint committee be appointed from the nations here represented, to make suitable recommendations carrying this proposal into effect."

From what has been said, it seems that this is quite reasonable and that the test piece must be taken from the casting itself, and, moreover, from various vital points of the casting if reliable information is expected. It would only be in the case that such a test is very costly that it would not be reasonable to adhere to it.

In his Paper to the Paris Congress Dr. Moldenke mentions that "The Fremont method would be nearly ideal from the scientific standpoint, though rather expensive from the practical one." The author felt constrained to mention in the discussion that it was quite a mistake. The Fremont test that he advocated in Birmingham two years ago consists of the shearing on a very small and cheap machine of a small test piece, less than ¼ in. dia., which is drilled out of a casting by a small hollow drill. [This was exhibited.] The hollow drilling for obtaining the test piece can be made either at the place of a bolt hole of the finished casting or in a place to be plugged afterwards, and when this is not possible in sacrificing one casting, but in all cases it is much cheaper than any other kind

* See F.T.J., August 17 issue, 1922.

of test, while it is much more reliable. In a small test piece 1 in. long, four or five tests can be made. This test does not give any information as to the soundness or internal strength; but so far it appears to the author to be the most reliable ever designed.

### Conclusion.

From this hasty survey it cannot be pretended that all points between the foundryman and engineer have been adjusted, but in summing up perhaps it can be considered that it has done some useful work.

The engineer, who requires strength and lightness, will do well to reduce the thicknesses of his castings as much as he can in spreading over the material rather than using heavy masses. He must make simple designs with round corners, avoid restricted places and enclosed cores, which are difficult to vent. Further, he will accept chills where heavy parts are unavoidable and insist upon soft, high silicon metal, so long as he knows that under above conditions it is stronger than hard iron. If the casting is liable to have strains, he will ask and pay for heat treatment.

The founder must spare no effort to produce sound, clean and smooth castings, supply good soft iron and improve his practice by every means.

The engineer will also do well to discuss with the foundryman the method of moulding, and will be agreeable that the pattern is made according to the latter's recommendation: he will supply the foundryman with as good and strong a pattern as is consistent with the number of castings to be produced. It is to be expected that by a confident collaboration, new progress will be made for the good of the industry.

## DISCUSSION.

### The Cumulative Ill-Effect of Non-Co-operation.

MR. F. C. EDWARDS congratulated the Birmingham Branch upon having secured the presence of a gentleman of such world-wide experience and reputation as M. Ronceray. The lecturer had covered considerable ground, some of which was no doubt very debatable, especially the references to gas troubles. Confining his remarks to the co-operation between the draughtsman and the foundryman, Mr. Edwards said he had had some years as an intermediary between the two, and he believed there was great and pressing need for an adjustment of the relations between those two departments. On the one hand, the requirements of the foundry were seldom, if ever, realised by the drawing office. On the other hand, the foundry itself was notoriously inarticulate in voicing its own legitimate requirements. They thus produced a condition which amounted to a sort of mutual reserve, which was not good for either the draughtsman or the foundry, and was certainly detrimental to the well-being of the engineering industry as a whole. Everyone present had heard the hackneyed remark: "You can never depend upon cast iron." The inference was, he supposed, that there was something inherent, something prejudicial in cast iron, which they could never control and which was liable to produce scrap castings at any moment. Many draughtsmen believed that it was impossible to depend upon cast iron, and acted upon that belief. Take an example. Certain parts of many castings were required to take a heavier load than other parts. What was the ordinary procedure of the draughtsman in those cases? He simply increased the metal at those points. The draughtsman increased the metal locally, the result being that, unless the moulder resorted to internal or external denseners or feeding—and these remedies could not always be resorted to—there was very frequently a scrap casting. The draughtsman then utilised that as a further piece of evidence that it was impossible to depend upon cast iron. Of course, they could never depend upon cast iron if they allowed a multiplicity of variables to usurp rational control in their methods of manufacture, for was there any manufactured article or naturally produced product under the sun upon which they could depend unless in its making the conditions of sound and reliable production had been fulfilled? Not one, he ventured to say. Was it too much to ask that in the sound production of castings the conditions should be favourable and not prejudicial to such production? Since both theoretical and practical foundrymen agreed that design played a fundamental part in determining the soundness of castings, was it too much to expect that the draughtsman should place the foundry point of view at least in the front rank of consideration, if not entirely first, when he was designing castings? That he should do so was, in his (Mr. Edwards') opinion, dictated not only by commonsense, but by the most elementary principles of economy, for they might safely say that a well-designed casting made of the worst metal could be expected to be stronger as a whole than a badly-designed casting made from the best metal obtainable.

### Piston Design.

MR. W. J. MOLYNEUX referred to the automobile piston to which reference had been made by M. Ronceray, and expressed the opinion that they would experience great difficulty in persuading designers in this country to forgo the four supporting ribs. They regarded it, he thought, as a very important matter to connect the piston boss with the cylinder head, especially in a piston of 96 up to 120 mm. diameter. Did the lecturer think that it was possible to get the weight of the piston down by sacrificing the ribs?

### A Metallurgical Reminder.

MR. A. MARKS said it was quite easily possible to obtain the same strength in a 2½-in. test-piece as in a 1-in. test-piece. He thought it should be kept in mind that strength was a function of the graphite. While the strength of cast iron might be an indirect function of the silicon, it was a direct function of the graphite.

### Reinforced Cast Iron and the Use of Metallic Paints.

MR. E. LONGDEN expressed his pleasure at finding that M. Ronceray practically endorsed all the conclusions that he (Mr. Longden) arrived at as a result of various experiments a short time ago. He called attention to an article recently published in THE FOUNDRY TRADE JOURNAL describing a new process for the production of cylinder castings which amounted to the actual metallising of the moulds and cores, especially in those parts prone to defects, and the conclusion arrived at was that the chilling effect created the soundness. He did not agree that that was the real effect. Why, in such thin sections as motor-car cylinders, should they get drawn places? There was no real bulk of metal to contend with. He considered that by more quickly freezing the metal they would reduce cavity, because they reduced the amount of time the gases could play off the awkward projecting sand corners. He also thought that possibly a much easier method would be to carry out experiments, as he was doing at the moment, in the direction of painting the corners of the awkward sections with a paste of ferro-manganese to accelerate the rate of cooling.

### Vote of Thanks.

Proposing a vote of thanks to M. Ronceray, MR. J. G. PEARCE, the Director of the British Cast Iron Research Association, said, in his opinion, there was an enormous amount to be gained by an interchange of ideas on an international scale, and that was a particular reason why the visit of M. Ronceray was so welcome. He thought the Institute was to be congratulated upon the steps that it had taken during the last few years to promote the interchange of ideas with other countries by the exchange of Papers with America and the Continent, by visits and international congresses and by the promotion of international standards for testing. By these means he thought the Institute was giving a remarkable lead and a fine lead to other institutions in this country. One thing evident from the remarks of M. Ronceray was the necessity for knowing more about the production of castings, the material that they used in the cupola, melting practice, methods of moulding and design, and methods of after-treatment and testing.

MR. W. J. FLAVELL, in seconding, agreed that it was very desirable that there should be a closer understanding between the designer and the man who had to carry out the work. Week after week

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they met with the difficulties due to design that had been outlined in the Paper. Recently his firm had received a pattern for a valve, one end of which was 1½ in. thick, the other side 1 in., and in between there was a plate of metal ⅜ in. thick. It was necessary to have a talk with the engineer, and he could at once see the difficulty arising from contraction. He had seen designs for the rear axle case of a motor-car where the strengthening ribs inside were put in diagonally. That meant to say that they had to be worked loose in the core box, which obviously involved considerable trouble. On inquiry it was found that, if put in at right-angles to the centre, they would serve equally well. Such an understanding took a considerable amount of expense off the job, both as to the moulder and the pattern-maker. In the lecture of M. Ronceray they had learnt much that would be beneficial to them in their trade.

The resolution was heartily endorsed by the meeting.

### The Author's Reply.

Replying upon the discussion, M. RONCERAY said there was no doubt in his mind that most of the difficulties experienced in the foundry were due to gas. The gas was not produced in the metal itself; it was caused by hot metal in contact with sand. As to the valve of the automobile pistons, he agreed that the weight could be reduced and still give satisfactory pistons. He was convinced that in cutting out the ribs they obviated defects. He did not say that silicon affected the strength of cast iron. He simply took Keep's curves as they were. The silicon effect on the strength of iron in that case was not purely the effect of silicon; it was a question of structure. He denied that the amount of graphite was of great importance, but the state of the graphite was. American black heart malleable was much stronger than cast iron, because the graphite was in a very fine state of division, and there were no flakes of graphite which cut the strength of the metal. It was not a question of metallurgy there; it was a question of metallography. It might be that some day foundrymen would find the correct texture. In fact, some work had been done in that direction, with pearlitic cast iron as a result, which he thought was a very big name for a very small thing. He, too, was glad to find Mr. Longden in accord with his conclusions. Referring to black points in flat plates, he attributed them to the absence of care in pouring the plates, with the result that small pieces of slag were incorporated in it. In his opinion, a test of an actual casting was more interesting than a test of a test-piece, especially in cast iron.

## Trade Talk.

McCALL & COMPANY (SHEFFIELD), LIMITED, 1, Cambridge Arcade, Sheffield, have removed to Mazda Buildings, Sheffield.

VIVIAN & SONS, LIMITED, of Swansea, have removed their London offices to Bartlett House, Basinghall Street, London, E.C.2.

THE STATE ENGINEER at Sydney, Mr. Bradfield, has recommended the Government to accept the tender of Dorman, Long & Company, Limited, for the construction of the North Shore Bridge.

A. G. PATERSON & COMPANY, of 166, Buchanan Street, Glasgow, have been appointed Scottish agents for Lewis Lazarus & Sons, metal merchants, 10 and 11, Lime Street, London, E.C.3.

NEGOTIATIONS have now been completed for the amalgamation of the Engineering, Shipbuilding, and Steel Commercial Staffs Association with the National Union of Clerks and Administrative Workers.

LICENCES UNDER the Non-Ferrous Metal Industry Act, 1918, have been granted by the Board of Trade to Mr. J. A. B. Carver, trading as Fraser-Carver & Company, 4, East India Avenue, London, E.C.3.

AT A MEETING of the Institution of Engineers and Shipbuilders in Scotland, held in Glasgow recently, Mr. W. H. Owen read a paper dealing with tests on a cylindrical marine boiler with and without preheated air.

AT THE FIFTH MEETING for the session of the Edinburgh and East of Scotland section of the Society of Chemical Industry, Dr. A. Lauder presiding, a paper was read by Mr. J. Adam Watson on "Factory Plant Records as a Control of Efficiency in Manufacture."

ASH & LACY, LIMITED, iron and steel makers, and iron and tinplate merchants, of Great Bridge, Tipton, and 40, Meriden Street, Birmingham, have appointed Mr. J. P. Lloyd and Mr. H. Bonsor as their representatives for the Eastern Counties and South Coast respectively.

THE IRON MERCHANTS' and coal export business of H. Ronnebeck & Company, Limited, Middlesbrough, of which the late Mr. H. Ronnebeck was the senior director, will be carried on as heretofore by the directors, who have been associated with the deceased gentleman for many years.

A CONTRACT has just been secured by J. & R. MacEwan, engineers and contractors, of Stockton, for the dismantling of the Howden (East Yorks.) airship station, which is described as the largest of its kind in the world. It was constructed during the war at a cost believed to be about £2,000,000, and is fully equipped.

CONTRACTS FOR ROLLING STOCK and electrical equipment of a total value of £48,255 have been placed by the Sheffield Corporation, including 25 vestibule tramcars (£24,150) from the Brush Electrical Engineering Company, Limited, and 50 traction motors from the British Thomson-Houston Company, Limited, to the value of £11,700.

KEEN DISSATISFACTION is felt that another contract for work in part of the British Empire has been secured by a German firm. It appears that an order for about 4,000 steel tyres for locomotives, carriages, and wagons had been placed by the High Commissioner of South Africa with the German firm of Krupps. A number of British firms submitted tenders, but they were seriously undercut.

THE Tottenham Urban District Council have accepted the tender of Vickers, Limited, Vickers House, Broadway, Westminster, S.W., for the installation of a complete clinker-crushing, elevating, grading, magnetic, separating and storage plant, to be delivered and erected at the Council's Refuse Destructor Works, Down Lane, Tottenham. The whole of the plant will be manufactured at Vickers' Barrow-in-Furness Works.

A NEW LAW has been promulgated at Buenos Aires and will come into force on November 10, 1924, by which foreign products imported or sold in the Argentine Republic must bear the name of the country of origin in a visible place on the containers, wrappers, or the products themselves, while the labels on the containers are to specify the quality of the product, the purity or mixture, and the net weights and measures of the contents.

THE BARROW HEMATITE STEEL COMPANY, LIMITED, are celebrating their diamond jubilee this year, having been established in 1864. Holders of the 5 per cent., income tax free, first debenture stock have been circularised by the directors, who are prepared to receive tenders, holders stating the price at which they are prepared to sell their stock, or any portion, to the company. The directors intend to purchase the stock at the lowest price offered, but do not bind themselves to acquire all or any stock offered. Of the issued first debenture stock there remains £896,297 outstanding.

CLAYTON & SHUTTLEWORTH, LIMITED, LINCOLN, have been successful in securing, during the last few weeks, several large contracts for "Clayton" water tube boilers. These include a repeat order from the Croydon Corporation for a 50,000-lb. boiler, the first "Clayton" having been in service for about 14 months; also two 50,000-lb. boilers with super-heaters, economisers, chain grate stokers, fans, chimneys, coal handling plant, etc., for the Sunderland Corporation Electricity Works, and two 40,000-lb. boilers with super-heaters, economisers, chain grate stokers, fans, etc., for the South Lancashire Tramways Company, Atherton, Lancs., where the plant is being modernised and extended.

ACTING ON BEHALF of Mr. D. R. Murray, of Murray, M'Vinnie & Company, Limited, ship furnishing ironmongers and merchants, Mavisbank Quay, Glasgow, Mr. Henry Wearing, of Glasgow, has purchased the engineering and boilermaking works in Govan belonging to Dunsmuir & Jackson, Limited, and known as the Govan Engine Works. It was announced in August last that Dunsmuir & Jackson had decided to retire from business, and go into voluntary liquidation, for the purpose of winding-up. The firm is a private one. Their works, which are situated in Prince's Street, Govan, near Prince's Dock, cover an area of 8¾ acres, and include machine shops, fitting and erecting shops, boiler shop, brass foundry, pattern shops, offices, and other departments. The engine shops are capable of turning out machinery of about 70,000 i.h.p. per annum, and the boiler shops about 100 marine type boilers per annum. In normal conditons the works found employment for about 1,000 men.

# The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

**Patent No. 5049.**

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

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## JAMES EVANS & CO., BRITANNIA WORKS (MANCHESTER), LIMITED.

## BLACKFRIARS, MANCHESTER.

# IRON AND STEEL MARKETS.

## Pig-iron.

**MIDDLESBROUGH.**—The delayed final settlement of the dockers' strike has had a further adverse effect upon pig-iron markets on Tees-side, and business as a consequence remains practically at a standstill during the current week. The extreme uncertainty of the position, shipments both abroad and coastwise being held up for the time being, has hindered deliveries, except by rail, with the result that stocks in makers' yards have accumulated to a serious extent, conditions which, if not speedily improved, must inevitably lead to a considerable restriction of outputs in the near future. The only partially satisfactory feature in the present situation, perhaps, is that while it has been impossible to ship iron abroad, it has been equally impossible to land cargoes of cheap competitive iron at British ports, with the result that buyers are practically confined to the home markets for the time being. It is not, however, surprising that Cleveland ironmasters are inclined to a pessimistic view of the future prospects of the industry, for even with the termination of the strike the continuous fall of the franc only accentuates the difficulties of the export side.

The hematite position on Tees-side is also far from reassuring. Makers are working through the bulk of the contracts made towards the end of 1923, and the volume of new business taken so far this year has been extremely disappointing. Moreover, export business has been falling off on account of French competition, while the dock strike not only prevented shipments against current contracts, but naturally prejudiced new inquiry.

**MANCHESTER.**—The position in the local pig-iron market continues uncertain, and it is more than usually difficult for the consumer to calculate the chances of the immediate future. In Manchester it is observed that consumers of foundry iron are very indifferent to the possibility of higher prices as a result of dearer fuel. It is probable that most consumers have pig-iron to come in sufficient for use during the next two or three months, unless the demand for castings should become very much larger than it is at present.

**THE MIDLANDS.**—At the Birmingham market last week makers reported that there is a slightly better inquiry for foundry iron, and that there has been more business in this direction of late than for a little time past.

**SCOTLAND.**—Conditions in the Scottish pig-iron industry disclose no improvement in the general position, but in market circles there is some anticipation of an increased demand shortly owing to the restriction of foreign imports, due to the disorganisation of the Continental exchange. Meantime, recent rumours of reducing the make has materialised, Messrs. Baird having decided to put off three furnaces at Coatbridge, which are at present making foundry iron. This will bring the number of furnaces making iron here down to a total of 42, of which 24 are on foundry, 14 on hematite, and 4 on basic.

## Finished Iron.

Business in this section of the market has been, perhaps, the least affected of the iron industries by the brief cessation of dock labour last week, and demand for most qualities of finished material continues fairly active. The manufacturers of nut and bolt iron have received more orders of late, due possibly to the fact that consumers are finding it very difficult to get any satisfaction concerning delivery of Continental supplies they have ordered; £11 10s. to £11 15s. is now being asked by the local mills for this grade of iron. Makers of marked bars and crown iron have fair order books, and continue to receive respectable specifications. Although the demand is improving quite appreciably, there is no alteration in prices.

## Scrap.

With few exceptions the various markets for scrap metal are reported extremely quiet, and so far as steel material is concerned business at Sheffield has come practically to a standstill. Most of the large steel-making firms have quite substantial stocks at their works, and are offering at the most 92s. 6d. delivered for heavy steel for melting. At this figure holders steadily refuse to do business, holding that the material is worth several shillings more. In Lancashire the demand for cast scrap is still only on a limited scale, ironfounders restricting buying, owing to the fact that in many cases the cupolas are idle.

## Steel.

The improvement recently reported in the demand for sectional material and joists has so far been maintained, and makers in the Midlands are said to be still receiving fresh specifications in these branches. It is understood, however, that their export order books are not large, the bulk of the specifications in hand being for work at home, so that the recent strike would not have affected the general outlook for some little time. In the Sheffield market the effect of the heavy imports of billets is making itself felt, and sales of home material continue to suffer, the lower price of the Belgian material being very tempting. To meet a continuance of this competition it may be necessary to ease the present quotations for basic billets, but so far no movement is recorded, and prices continue as last. Acid billets continue firm, with no great amount of business doing. There is an improving demand for high-grade steels, and high-speed and other tool steels are doing better. There has been more inquiry for tinplates recently, a fair proportion of business resulting. A suggestion was made the other day that the minimum selling price be advanced 1s. basis, but nothing definite was fixed, although it is generally thought that 24s. 6d. will be agreed on shortly, especially with tin continually rising as it is doing. Transactions were freely negotiated at 24s. to 24s. 3d.

## Metals.

**Copper.**—Following the sharp upward movement in standard copper previously reported, a reaction was subsequently in evidence and values returned to somewhat lower levels. This easier tendency was to be attributed to the comparative cheapness of the metal, while there has been a more active trade demand in the States, chiefly for domestic use, considerably larger quantities having been purchased in the earlier part of this month, and manufacturers have shown a disposition to anticipate their needs into next quarter. There has also been an improved demand from home and Continental consumers, and this, together with the more reserved attitude of sellers in the speculative medium, has caused prices to respond sharply. Current quotations:—*Cash*: Thursday, £63 12s. 6d.; Friday, £62 17s. 6d.; Monday, £63 10s.; Tuesday, £63 12s. 6d.; Wednesday, £65. *Three Months*: Thursday, £64 10s.; Friday, £63 15s.; Monday, £64 7s. 6d.; Tuesday, £64 7s. 6d.; Wednesday, £65 15s.

**Tin.**—Movements in this section of the market have been again evidenced by exceptional strength, but have also been marked by occasional fluctuations tending to reactionary indications. The advances during the past week have been made in the face of considerable profit-taking, and, apart from natural reactions attendant on sudden movements, there is little in the position to suggest much easier conditions for a considerable period. The South Wales tinplate makers have been busy for some time past, and have further advanced prices, placing them 1s. per standard box above the official minimum. Tin stocks have been steadily decreasing, those in London warehouses now being down to 984 tons, compared with 1,702 tons at the commencement of the year. It is, moreover, stated that supplies afloat are largely earmarked for South Wales and for transhipment to America. Current quotations:—*Cash*: Thursday, £278; Friday, £274; Monday, £275 5s.; Tuesday, £280 15s.; Wednesday, £280 15s. *Three Months*: Thursday, £275 12s. 6d.; Friday, £272 5s.; Monday, £274 15s.; Tuesday, £279 10s.; Wednesday, £279 10s.

**Spelter.**—Steadily increasing strength is apparent in the market for this metal, supported by an active demand from consumers. American stocks have again increased, but there is little being sold for export to this country, and the Continental zinc producers resist all efforts to make them sell. Consumers here are not well covered. Current quotations:—*Ordinary*: Thursday, £37; Friday, £37; Monday, £37 2s. 6d.; Tuesday, £37 7s. 6d.; Wednesday, £37 10s.

**Lead.**—The market for soft foreign pig continues fairly active, but the general conditions are unchanged. The market is in a strong position; consumption is large, and seems likely not only to be maintained, but developed further, whilst at the same time the high price fails to stimulate output in any part of the world in a sufficient degree to cope with growing demand. Current quotations:—*Soft foreign (prompt)*: Thursday, £35; Friday, £35 5s.; Monday, £35 7s. 6d.; Tuesday, £35 15s.; Wednesday, £36 2s. 6d.